

Archaeozoology of the Near East

editor

**Marjan Mashkour, Mark
Beech**

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ARCHAEOZOOLOGY of the Near East 9

edited by Marjan Mashkour and Mark Beech



ARCHAEOZOOLOGY OF THE NEAR EAST 9



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Archaeozoology of the Near East 9

In honour of Hans-Peter Uerpmann and François Poplin

edited by

Marjan Mashkour and Mark Beech

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Foreword: Introduction to ASWA

The *Archaeozoology of the Southwestern Asia and Adjacent Areas* research group, known as ASWA, was founded in 1990 during the VIth International Council for Archaeozoology – ICAZ congress at Washington DC in the United States. This group was created because of the growing number of archaeozoologists working in the Near and Middle East. Archaeozoology (also called zooarchaeology) is the study of the relationships between humans and non-human animals over time. It usually involves the study of animal remains (often called faunal remains) from archaeological sites.

The aim of creating the ASWA working group was to promote communications between researchers working on the faunal material of the Near and Middle East, as well as neighbouring spheres. These specialists often have common similar and complementary methodological research questions in relation to the different cultures that settled and succeeded in the region.

The ASWA group does not propose any particular theme for the meeting since it echoes on-going research in the specific field of archaeozoology and man–animal relationships (anthropozoology). The papers collected here cover a geographic area from India to the Balkans and from north Africa to the Caucasus, with the Near and Middle East as the central focus region. Chronologically they span from the Palaeolithic to pre-modern times.

Archaeozoological studies in the Near and Middle East have examined a number of themes of interest such as: the implication of faunal studies in the reconstitution of landscapes, climates and past environments, the identification and description of species and their variety in time and space, an understanding of animal domestication, analysing ancient food economies, hunting strategies and the socio-cultural aspects of faunal exploitation by past societies.

The first ASWA meeting was held in June 1992 at Groningen in the Netherlands uniting 37 specialists. The proceedings were published the next year, and since that time the ASWA group has met on a regular basis every 2 years, once in a European country and when

possible once in an Eastern European or Near/Middle Eastern country. The publication of papers presented at ASWA meetings is generally taken in charge by the editorial house ARC in Groningen.

The success of these meetings and the important work of these specialists is demonstrated by the fact that during the course of the past 14 years there has been no gap in these meetings and in their subsequent publication (see below for details). Moreover, internationally, the ASWA group has mirrored the major advances in research on Near and Middle Eastern archaeozoology.

Between 30 and 70 specialists from 14 different countries of the region usually gather to attend ASWA meetings. One of the most important aims of these meetings is to encourage scholars from developing countries, students and young researchers to participate in these meetings. It is the duty of the organisers to find funding for helping partially or totally funding these latter mentioned researchers.

ASWA working group meetings

1st ASWA: Groningen, Netherlands (organized by Hylke Buitenhuis & A.T. Clason), June 1992.

2nd ASWA: Tübingen, Germany (Hans-Peter & Margarethe Uerpmann), September 1994.

3rd ASWA: Budapest, Hungary (Laszlo Bartosiewicz & Alice Choyke), September 1996.

4th ASWA: Paris, France (Marjan Mashkour & François Poplin), June 1998.

5th ASWA: Irbid, Jordan (Abdel Halim al-Shiyab), April 2000.

6th ASWA: London, England (Louise Martin), August 2002.

7th ASWA: Ankara, Turkey (Evangelia Piskin Ioannidou), June 2004.

8th ASWA: Lyon, France (Emmanuelle Vila & Lionel Gourichon), June 2006.

9th ASWA: Al Ain, United Arab Emirates (Marjan Mashkour & Mark Beech), November 2008.

10th ASWA: Brussels, Belgium (Beatrice De Cupere, Veerle Linseele, Wim Van Neer), June 2011.

11th ASWA: Tel Aviv, Israel (Irit Zohar & Guy Bar-Oz), June 2013.

12th ASWA: Groningen, Netherlands (Canan Cakirlar, Rémi Berthon & Jwana Chahoud), June 2015.

Publications of the ASWA working group (in chronological order)

Buitenhuis, H. & Clason, A. T. (eds). 1993. *Archaeozoology of the Near East*. Universal Book

- Services/Dr W. Backhuys, Leiden.
- Buitenhuis, H. & Uerpmann, H.-P. (eds). 1995. *Archaeozoology of the Near East II*. Backhuys Publishers, Leiden.
- Buitenhuis, H., Bartosiewicz, L. & Choyke, A. M. (eds). 1998. *Archaeozoology of the Near East III*. ARC Publication 18, Center for Archeological Research and Consultancy, Rijksuniversiteit Groningen, Netherlands.
- Mashkour, M., Buitenhuis, H., Choyke, A. M. & Poplin, F. (eds). 2000. *Archaeozoology of the Near East IV*. ARC Publication 32, Center for Archeological Research and Consultancy, Rijksuniversiteit Groningen, Netherlands.
- Buitenhuis, H., Choyke, A. M., Mashkour, M. & Al-Shiyab, A. H. (eds). 2002. *Archaeozoology of the Near East V*. ARC Publication 62, Center for Archeological Research and Consultancy, Rijksuniversiteit Groningen, Netherlands.
- Buitenhuis, H., Choyke, A. M., Martin, L., Bartosiewicz, L. & Mashkour, M. (eds). 2005. *Archaeozoology of the Near East VI*. ARC Publication 123, Center for Archeological Research and Consultancy, Rijksuniversiteit Groningen, Netherlands.
- Vila, E., Gourichon, L., Choyke, A. M. & Buitenhuis, H. (eds). 2008. *Archaeozoology of the near East VIII*. Travaux de la Maison de l'Orient et de la Méditerranée 49, Lyon.
- De Cupere, B., Linseele, V. & Hamilton-Dyer, S (eds). 2013. Proceedings of the 10th Meeting of the ICAZ Working Group 'Archaeozoology of southwest Asia and adjacent Areas'. Ancient Near Eastern Studies Supplement Series 44. Peeters Publishing, Leuven.
- Mashkour, M. & Beech, M. J. (eds). 2015. *Archaeozoology of the Near East IX*. Proceedings of the Ninth International Symposium on the Archaeozoology of South-Western Asia and Adjacent Areas. Oxbow Books, Oxford.

Why Abu Dhabi and the United Arab Emirates?

Abu Dhabi is fast becoming the cultural centre of the region, and the former Abu Dhabi Authority for Culture and Heritage (ADACH), now known as the Abu Dhabi Tourism and Culture Authority (TCA Abu Dhabi), is playing an important role in promoting national culture and identity. Abu Dhabi today hosts many important international meetings, making a vital contribution towards research on the culture of the Middle East. The only previous ASWA meeting to be held in south-west Asia was that which took place in Jordan in 2000. It therefore seemed an opportune moment to hold such an event.

Why Al Ain?

Al Ain is one of the richest archaeological regions of the United Arab Emirates, being located on the edge of the great Empty Quarter or Rub Al-Khali Desert and the mountains of the Oman peninsula. The Cultural Sites of Al Ain (Hafit, Hili, Bidaa Bint Saud and the Oases Areas) in 2011 became the first UNESCO World Heritage site to be established within the United Arab Emirates. The sites constitute a serial property that testifies to sedentary human occupation of a desert region since the Neolithic period with vestiges of many prehistoric cultures. Remarkable vestiges in the property include circular stone tombs (ca. 2500 BC), wells and a wide range of adobe constructions: residential buildings, towers, palaces and administrative buildings.

Hili moreover features one of the oldest examples of the sophisticated aflaj irrigation system, which dates back to the Iron Age. The property provides important testimony to the transition of cultures in the region from hunting and gathering to sedentarisation.

It is therefore a very appropriate place to organise such a conference. The city is home to the only Federal university in the UAE, the United Arab Emirates University (UAEU). It also houses an important archaeological museum and many historic forts and buildings. The city of Al Ain is located in an exceptional landscape. From the Mercure Hotel, located on the summit of the mountain Jebel Hafit, where the conference will take place, the magnificent desert and its surroundings can be admired. Excursions to different destinations in the immediate proximity of Al-Ain or to other Emirates can easily be organised via various tourist companies. Al-Ain has a long history of involvement with nature conservation in terms of preservation of the unique oasis environments, and their surrounding desert areas. Al Ain zoo houses an important collection of rare Arabian animals including Arabian oryx and gazelle.

Honouring two pioneers of Archaeozoological research

Two important personalities in the field of Archaeozoology were honoured at the 9th ASWA meeting, Professor Hans-Peter Uerpmann (Germany) and Dr François Poplin (France). These are both pioneers in the discipline of Archaeozoology. Both have worked in the United Arab Emirates or on material coming from this region.

Hans-Peter Uerpmann (University of Tübingen, Germany) is a specialist of animal domestication. His research has focused on the Northern Emirates and Oman and on the investigation of prehistoric economies and environments, including the archaeology of the dromedary camel.

François Poplin (Natural History Museum of Paris, France) is the founder of anthropozoology and a specialist of hard animal material (bone, teeth and ivory). He is particularly interested in man–animal symbolic relationships through the production of artistic objects made of dugong, rhinoceros and elephant ivory.

Conference programme

Following the papers given on the first day, we were kindly hosted for dinner by Mohammed Amer Al-Neyadi (Director of the Historic Environment Department at the former ADACH, now known as TCA Abu Dhabi) at the Al Ain Palace Museum. All the conference delegates enjoyed a traditional Arabian buffet style feast sitting outside in the

courtyard of the old palace where the late President of the UAE had once lived. After three days of conference papers and poster presentations, the concluding conference dinner took place at Al Ain Zoo. A sumptuous Arabian banquet was held in the open air, right next to the enclosure holding the Arabian oryx and gazelle. Live oud music provided a charming and atmospheric finale to the conference.

During the conference several visits and excursions were organised to the Al Ain National Museum and Al Ain Palace Museum, to the Oases around the city and a one-day excursion to the Hili Archaeological Park and Mezyad Hafit tombs at Jebel Hafit. This was followed by a visit to the Sharjah Archaeology Museum and the Arabian Wildlife Centre in Sharjah. The excursion concluded on the way back to Al Ain by stopping for a desert walk just before sunset in the sand dune area at the south of the Al Madam plain, where some delegates could not resist collecting some modern camel bones they discovered between the dunes!

A total of 51 delegates including European (France, England, Germany, Belgium, Italy, Netherlands, Romania), North American, and south-west Asian countries (UAE, Syria, Lebanon, Turkey, Iran, Armenia, Palestine), and Japan participated in the 9th ASWA conference in Al Ain. The papers delivered at the conference covered a wide geographic from Central Asia, the Near East, Caucasus, and Arabia to Egypt. The topics of the conference included Hunter-gatherers subsistence, domestication, herd mobility, animals in rituals, bone industry with the integration of new analytical techniques such as stable isotopes.

More than 70 persons attended the conference. These included representatives from the former Abu Dhabi Authority for Culture and Heritage (now known as the Abu Dhabi Tourism and Culture Authority), United Arab Emirates University, Zayed University, and Emirates Natural History Group.

The proceedings of the conference

The present volume includes 31 papers. Following a foreword by the official authorities in Abu Dhabi, there are tributes to two pioneering researchers in Archaeozoology. Nicolas Conard (University of Tübingen) writes a foreword in honour of Hans-Peter Uerpmann and his contribution to the Archaeozoology of the Near East. Christine Lefèvre (Natural History Museum of Paris) then writes a tribute concerning the contribution of François Poplin to Archaeozoological studies. The following major themes were discussed during the conference: *Palaeolithic and Neolithic Subsistence in Northern*

Mesopotamia, Anatolia and the Iranian Plateau; Caucasian Zooarchaeology; Animal Exploitation on Urban Sites During the Bronze Age; Pastoralism, Nomadism and Mobility; Exploitation of Animals in the Arabian Peninsula; Rituals and Animal Deposits and finally – Animal Exploitation During Antiquity.

Acknowledgments

The ASWA conference in Al Ain could have not taken place without the help and support of the following people: the late H. E. Mohammad Khalaf al Mazrouei (former Director-General of the Abu Dhabi Authority for Culture and Heritage – ADACH), H. E. Zaki Nusseibeh (former Deputy Chairman of ADACH), and Dr Sami El Masri (Deputy Director-General of ADACH), as well as Mohammad Amer Al-Neyadi (Director of the Historic Environment Department at ADACH). The following personnel from the Historic Environment Department at ADACH should also be thanked for their contribution: Jaber Al-Merri, Mohammed Matar Al-Dhaheri, Tariq Al Baloushi, Mohammed Al Harmoudi, Hamdan Al-Rashidi, Ali Al-Meqbali, Ahmed El-Haj and Dia'eddin Tawalbeh.

The ASWA conference was sponsored by Service de Cooperation et d'Action Culturelle (SCAC) at the French Embassy in Abu Dhabi and the Bank of Sharjah. Special thanks are due to Didier Gazagnadou and to Varouj Nerguizian. Our thanks go also to the Mercure Hotel – Jebel Hafit and the Thales group that sponsored the conference.

Thanks go to Dr Anjana Reddy Lingareddy for her unstinting patience and hard work in dealing with a lot of the administration and daily duties during the conference and field trip. Anjana also assisted with a lot of the copy editing of papers in this volume.

We would like to thank and acknowledge the work and assistance of our many research colleagues who assisted with the reviewing of all the papers in this volume.

Also, thanks go to Oxbow Books, and in particular to Sarah Ommanney, Julie Gardiner, Mette Bundgaard and Clare Litt for their patience and diligence in dealing with the publication of this volume. Finally, thanks to Julie Blackmore of Frabjous Books for the typesetting services provided.

Marjan Mashkour and Mark J. Beech

Foreword: Introduction to ASWA

Mohamed Al-Neyadi

Director of the Historic Environment Department at the Abu Dhabi Authority for Culture and Heritage

Ladies and Gentlemen

Building upon its strategy of protecting and promoting cultural heritage, the Abu Dhabi Authority for Culture and Heritage (ADACH) is proceeding with the implementation of a number of current and future projects. These concern the organisation and development of the means necessary to oversee archaeological restoration, survey and exploration in accordance with scientific methods based on approved global standards.

This strategy has resulted in the achievement of a variety of the Authority's objectives, including the discovery of many new archaeological sites in a short period of time. Examples include new discoveries at the fossil site at Ruwais in the Western Region, which dates back to the late Miocene Period 6–8 million years ago, as well as previously unknown Neolithic sites dating back to over 7000 years ago.

In cooperation with museums and international bodies concerned with natural history, important discoveries have continued, finding new sites dating back to ancient periods in the Emirate of Abu Dhabi. This was done through surveys conducted by local and international teams of experts from the Historic Environment Department at ADACH, particularly on sites in the Western Region, dating back as far as 200,000 years. This takes the earliest history of Abu Dhabi back to the Palaeolithic rather than the Neolithic as was originally thought.

Given the importance of these discoveries, ADACH has contributed to research papers in Arab and international seminars. It also organises many seminars and workshops on prehistoric technology,

and on scientific methods in archaeology. All this is in keeping with the desire of ADACH to develop the skills of its archaeologists, researchers and museum workers.

We are pleased to meet you today on the occasion of the 9th meeting of the Archaeozoology of Southwest Asia and Adjacent Areas (ASWAAA), discussing projects that examine past relationships between humans and animals through study of the remains of animals at archaeological sites, giving us a deeper understanding of ancient environments.

I am pleased to extend my sincere thanks to all the sponsors of the meeting: the French Embassy in Abu Dhabi, Bank of Sharjah, Dassault Aviation, Mercure Grand Hotel Al Ain, and the French National Centre for Scientific Research.

We would also like to thank representatives of the media for their role in highlighting the great importance of preserving the heritage of the United Arab Emirates, and the efforts of the Authority and its quest to build local expertise to develop, maintain and research heritage.

Speech of 16 November 2008

السيدات والسادة / الحضور الكريم :

يشرفنى أن ألتقيكم فى هذا اليوم الجميل وفى هذا المكان المتميز وفى هذه المناسبة المهمة الا وهى إنعقاد المؤتمر التاسع لعلم الآثار والحيوان لإقليم جنوب غرب آسيا والمناطق المجاورة والذي ينعقد فى هذه المرة بمدينة العين بدولة الإمارات تلك البقعة من الأرض التى شهدت على وجود علاقته قديمة بين الإنسان والحيوان وعلى وجود أنواع متعددة من الحيوانات المستأنسه والغير مستأنسه حيث دلت الإكتشافات التى تمت فى السابق بالتعاون مع جامعات وجهات علمية عالمية على ذلك.

ولما كانت هيئة أبوظبى للثقافة والتراث هيئة أبوظبى للثقافة (تنطلق من إستراتيجية تنطوى على إعطاء أهمية قصوى لحماية التراث الثقافى المحلى تعزيزاً للهوية الوطنية كان لابد من إبتداع وإتباع سبل علمية لإدارة عمليات المسح والتنقيب الأثرى وأيضاً عمليات نقل وترميم المكتشفات ومن ثم الحفاظ عليها وفق المعايير العالمية المعتمدة فى هذا الشأن.

بالتالى وإنطلاقاً من هذه الإستراتيجية حرصت الهيئة كل الحرص على رعاية هذا الإجتماع المهم والمتعلق بدراسة العلاقة بين الإنسان والحيوان ويرتبط بدراسة عدة مشاركات علمية فى الكثير من المؤتمرات والمحافل العالمية من قبل الهيئة حول هذا الموضوع حظيت بإهتمام العديد من الجهات ذات الصلة.

عليه نتمنى أن يتم التوصل إلى نتائج مهمه تشكل إضافات علمية جديدة لهذا الموضوع وتلقى لنا الضوء على بعض جوانب البيئة المحلية فى تلك الحقبة الزمنية وتدل على أنماط حياة معينة للإنسان القديم.

السيدات والسادة:

اسمحوا لى أن أتوجه بجزيل الشكر للسادة الرعاة لهذا الحدث المهم وكذلك نشكر حضوركم الكريم ونأمل لكم إقامة طيبة بمدينة العين فى واحدة من أكثر الأماكن تميزاً فيها الا وهى جبل حفيت حيث قمنا كذلك بوضع برنامجاً خاصاً للتجول فى العديد من المواقع الأثرية فيها.

Foreword

Didier Gazagnadou

Professor of anthropology at University Paris VIII, Cooperation and cultural action counsellor French Embassy in the United Arab Emirates (2007–2010)

When the project of organising an international archaeozoology colloquium in al-‘Ain was presented to the Service of Cooperation and Cultural Action (SCAC) of the French Embassy by Dr M. Beech (Abu Dabi Authority for Culture and Heritage – ADACH-EAU) and Dr M. Mashkour (CNRS-MNHN-FRANCE), it was with pleasure that I accepted to engage the participation of the cultural service in organising this event.

Archaeological research involves a cultural, historic, political and diplomatic dimension. Indeed, archaeological research and discoveries add depth to the history and the culture of a country. For this reason, the United Arab Emirates, who only became independent recently, encourage all activity leading to a greater understanding of the past in this region. Therefore, archaeological research in general and French research in particular, has always benefited from the support of the cultural and political Emirate authorities. Thus, M. Mohamed Khalaf al-Mazroui (Director-General of the ADACH) replied favourably to my request for support and collaboration for the organisation of this international colloquium within a week.

French archaeological research began with the excavations and the major discoveries at al-‘Ain, led by Professor Serge Cleuziou. Today, this research is well-established in the United Arab Emirates and continues in the Sharjah, Fujeira, Ajman and Ras al Khaimah Emirates.

This colloquium is the second international ASWA (Archaeozoology of Southwest Asia and Adjacent areas – ICAZ International Council for Archeozoology) archaeology colloquium to be organised in an ASWA

zone, bringing together researchers from very different countries: the United Arab Emirates of course, but also Armenia, Iran, Syria, Lebanon, Turkey, Palestine, the United States of America, Europe and Japan.

From a scientific point of view, this colloquium has helped to reveal new discoveries, to raise new questions and to rectify certain hypothesis. As an anthropologist working in the region, I was particularly interested in the papers concerning the dromedary site in the Ruwais region and the dromedary remains in the Sharjah Emirate, as they are directly related to the history of the United Arab Emirates and the Arabian Peninsula. These articles raise the important question of the domestication of the dromedary in Arabia, a pivotal issue for the history of nomadism, the structure of Bedouin society and commerce in the Arabian Peninsula before and after Islam. The history of the Arabic peninsula and the région cannot be separated from the history of the dromedary domestication.

This international colloquium will also have contributed to reinforcing cooperation and friendship between France and the United Arab Emirates, as well as encouraging ongoing research in the Middle East and in southwest Asia. This colloquium also led to the publication of a scientific volume accessible to researchers in the Emirates and the rest of the world. This type of cooperation is essential for weaving links between people and produces useful archaeological and scientific material; some of which will shortly be exhibited in the new Louvre Abu Dhabi and Cheikh Zayed National Museum.

I wish to express my thanks to Mohamed Khalaf al-Mazroui, Ex-Director-General of the ADACH, Zaki Nusseibeh, Ex-Vice-President of the ADACH, Mohamed Niyadi, Representative of the ADACH (currently TCA Abu Dhabi) in al-'Aïn and Patrice Paoli, French Ambassador to the United Arab Emirates, for supporting the colloquium project, and without whom this venture would not have been possible.

I would also like to thank all the staff of the Cooperation and Cultural Action Service of the French Embassy who contributed to the success of this colloquium: Mr Jean-Philippe Rot, secretary of the SCAC, Ms Ondine Diakhaté and Aurélie Cousergues, responsible for the mission, as well as Ms Ingrid Jouette-Nagati, French cooperation attaché.

Thanks are also due to the companies who kindly accepted to sponsor this colloquium, and in particular to Mr Varouj Nerguissian, Director of the Sharjah Bank, who made a significant and decisive contribution, but also to Dassault, Thalès and the al-'Aïn Mercury

Paris, October, 19, 2012

Quand le projet d'organiser un colloque international d'archéozoologie à al-'Aïn a été proposé au Service de Coopération et d'Action Culturelle (SCAC) de l'Ambassade de France par le Dr. M. Beech (Abu Dabi Authority for Culture and Heritage – ADACH-EAU) et le Dr. M. Mashkour (CNRS-MNHN-FRANCE), c'est bien volontiers que j'ai accepté d'engager le service culturel à participer à l'organisation de cet évènement.

Il y a dans la recherche archéologique une dimension culturelle, historique, politique et diplomatique. En effet, les recherches et découvertes archéologiques donnent une profondeur à l'histoire et à culture d'un pays. C'est pourquoi les autorités des Emirats Arabes Unis, dont l'indépendance est récente, encouragent tout ce qui permet de comprendre le passé de cette région. Pour ces raisons, les recherches archéologiques, françaises en particulier, ont toujours bénéficié du soutien des autorités culturelles et politiques émiriennes. Ainsi, M. Mohamed Khalaf al-Mazroui (Directeur Général de l'ADACH) avait répondu favorablement en huit jours à ma demande de soutien et de collaboration pour l'organisation de ce colloque international.

La mission archéologique française aux Emirats Arabes Unis est ancienne et a commencé ses fouilles sous la direction de feu le Professeur Serge Cleuziou qui a fait d'importantes découvertes à al-'Aïn. Elle poursuit aujourd'hui encore ses travaux dans les Emirats de Sharjah, de Fujaira, d'Ajman et de Ras al Khaimah.

Mais ce colloque avait une originalité, celle d'être le premier colloque international d'archéozoologie d'ASWA (Archaeozoology of Southwest Asia and Adjacent areas – ICAZ International Council for Archeozoology) à être organisé dans un pays arabe et où des chercheurs de pays très différents ont été invités : des Emirats Arabes Unis bien sûr, mais aussi d'Arménie, d'Iran, de Turquie, de Palestine, du Japon, des Etats-Unis et d'Europe.

Sur le plan scientifique, ce colloque a permis de mettre au jour de nouvelles découvertes et de poser de nouvelles questions voire de corriger certaines hypothèses. En tant qu'anthropologue de la région, je pense en particulier – car cela concerne directement l'histoire des Emirats Arabes Unis et de la péninsule arabique – aux communications qui ont été faites, l'une à propos d'un site de dromadaires trouvé dans la région de Ruwais ou l'autre, à propos d'un

site où se trouvaient des restes de dromadaires dans l'Emirat de Sharjah. Ces exposés soulèvent l'importante question de la domestication du dromadaire en Arabie, question décisive puisqu'elle en rapport direct avec l'histoire du nomadisme, de la structure de la société bédouine et du commerce dans la péninsule arabique avant et après l'Islam. L'histoire de cette région ne peut être séparée de celle de la domestication de ce camélidé.

Ce colloque international a contribué à la fois à renforcer la coopération et les liens d'amitiés entre la France et les Emirats Arabes Unis ainsi qu'au développement des recherches sur la zone du Moyen-Orient et de l'Asie du Sud-Ouest. Ce colloque a permis la publication d'un ouvrage scientifique à la portée des chercheurs émiriens et du reste du monde. Ce type de coopération permet de tisser des liens entre les personnes et laisse des matériaux archéologiques et scientifiques utiles ; matériaux d'autant plus intéressants et utiles qu'ouvriront bientôt le musée du Louvre Abu Dhabi et le musée national Cheikh Zayed.

Je tiens à vivement remercier Mohamed Khalaf al-Mazroui, Directeur Général de l'ADACH, Zaki Nusseibeh, Vice-Président de l'ADACH, Mohamed Niyadi, Représentant de l'ADACH à al-'Aïn et Patrice Paoli, Ambassadeur de France aux Emirats Arabes Unis, pour leur appui immédiat et leur soutien à ce projet de colloque, sans qui celui-ci n'aurait jamais pu se tenir.

Il me faut aussi remercier tous les personnels du Service de Coopération et d'Action Culturelle de l'Ambassade de France qui étaient alors en poste et ont largement contribué à la réussite de ce colloque : M. Jean-Philippe Rot, secrétaire du SCAC, les deux chargées mission, Mesdemoiselles Ondine Diakhaté et Aurélie Cousergues ainsi que Madame Ingrid Jouette-Nagati, attachée de coopération pour le français.

Doivent être également remerciées, les entreprises qui ont accepté de sponsoriser ce colloque et en tout premier lieu M. Varouj Nerguissian, Directeur de la Banque de Sharjah dont l'importante contribution a été décisive, sans oublier les sociétés Dassault, Thalès et l'Hotel Mercure d'al-'Aïn.

Foreword in honour of the two pioneering researchers in Archaeozoology

The contribution of Hans Peter Uerpmann to the Archaeozoology of the Near East

Nicolas Conard

Although I knew of Hans-Peter Uerpmann's research and reputation before I moved to Tübingen, it was through our work together in the Department of Early Prehistory and Quaternary Ecology that we got to know each other well. For 15 years from 1995 to 2009 Hans-Peter and I ran the affairs of the department with all its complexities, with many more successes than failures. Although Hans-Peter is now retired, we continue to work together in a wide range of scientific contexts. Over the years, we co-supervised more than 30 master's theses and 20 doctoral dissertations. We also occasionally published together and had several joint excavations and research grants. Hans-Peter was my closest colleague at the University and my closest partner for innumerable debates, conflicts and successes that shared university life brings with it. Thus I have had many chances to work with him in all sorts of different settings.

Before turning my attention to Hans-Peter Uerpmann, I also wish to mention that I am pleased to do this in the context of a publication dedicated to both Hans-Peter and Francois Poplin. While my relationship with Francois Poplin is a very different one, I would like to mention my appreciation for his having included me on his excavation team at Roche-au-Loup near the Yonne River in Burgundy in 1986. Francois showed me much about archaeology and zooarchaeology at his field camp under a large banner bearing the name BUFFON. He also treated me with great kindness in the field and at his homes in Auxerre and Paris. The enormous pleasure I had as his sidekick and helper on numerous excursions, shopping runs and

most particularly on visits to vineyards and wine cellars, belong to some of my best memories as an archaeologist. The time spent with Francois Poplin in his native countryside was a joy, for many scientific and personal reasons. Whether singing in his excavation choir or digging the transition between the Middle and Upper Paleolithic by the light of carbide lamps, the time spent in camp Buffon was unforgettable. Francois' unusual skills and many passions have no doubt at times surprised and inspired many natural historians as they did me. This is not the place to dwell on these fond memories, other than noting my thanks to Francois Poplin for his generosity when I was a student and for our collegial interaction in more recent years.



Returning to my main topic, Hans-Peter Uerpmann was born in Hohenlimburg near Hagen in Westphalia on All Saints' Day in 1941. His father was killed in fighting on the Eastern Front in January after his birth. Hans-Peter's family moved to Plüderhausen near Stuttgart where he spent his early years and attended school. He, like the many other German children born during World War II and the populace in general, faced considerable adversity in his early years during the war and in the lean years after the war.

After initially completing school in Schorndorf, he entered a

training course as a mechanic in Grunbach. He later enrolled in the Schorndorf *Gymnasium*, where he earned his *Abitur* and qualified for university studies. In keeping with the spirit of Jack London and Josef Conrad, he enlisted on a freighter and took to the sea. He sailed along the African coast to Senegal, the Canary Islands and to ports in northern Scandinavia. Only after satisfying his *Wanderlust*, did he turn his attention to science. This being said, he chose a career that was compatible with his longing to travel to remote and exotic places.

Hans-Peter Uerpmann enrolled in a leading program for veterinary medicine at the Ludwig-Maximilian-University in Munich. Here he worked closely with Prof. Joachim Boessneck and earned a doctoral degree in 1968 with a dissertation about prehistoric faunal economies and paleoenvironments of Mallorca. After finishing this degree he decided that archaeozoology was impossible without archaeology and went to the University of Freiburg to study Pre- and Protohistory with Edward Sangmeister and Wilhelm Schüle. Much of Hans-Peter's early research drew upon data from prehistoric Spain and focused on a wide range of methodological issues.

In 1971 Hans-Peter and his wife Margarethe moved to Tübingen for studies with Prof. Hansjürgen Müller-Beck, Wolfgang Taute and other members of the Institute for Prehistory. On many occasions both Margarethe and Hans-Peter have told me of the enthusiasm for prehistory and scientific archaeology that permeated Schloss Hohentübingen in those days. Müller-Beck had a passion for the archaeology of hunters and gatherers, and unlike most of his peers and contemporaries embraced many innovations and welcomed researchers working at the interface between archaeology and the natural sciences.

Later the Uerpmanns returned to Freiburg for a short time, where Hans-Peter continued his studies with Prof. Sangmeister, a leading scholar for the Neolithic. Sangmeister was an open-minded teacher and *Doktorvater*, who gave Hans-Peter the freedom he needed to start work on his second doctoral dissertation, this time in prehistory. It was conceived as dealing with the spread of Neolithic economy in the Mediterranean Region, at first focusing on the western part of it. This soon changed when Uerpmann was offered a research position in the *Tübinger Atlas des Vorderen Orients (TAVO)*, which brought the Uerpmanns back to Tübingen, where subsequently their three children were born. Working for the 'Tübingen Atlas' under the direction of Wolfgang Röllig gave him a wide range of opportunities to extend his research into the eastern Mediterranean and Southwest Asia. In his archaeological thesis focusing on faunal assemblages from the Near

East, Hans-Peter presented a wealth of new data on the domestication of animals, and postulated that rapid expansion of grasslands in connection with climatic amelioration at the end of the Pleistocene served as a trigger that gave rise to large-scale agriculture. Only with the subsequent domestication of animals were the economies of the Near East able to sustain larger villages, which eventually evolved into cities. This research and Hans-Peter's ongoing work on these questions represent one of his most important contributions to archaeology.

At this time in the late 1960s and the 1970s zooarchaeology was not yet an established discipline, and Hans-Peter Uerpmann's research often addressed fundamental questions of recording data, quantifying patterns of variation, and defining ways to identify domesticates. These publications helped to lay the foundation for the new field and continue to be used by many colleagues and former students. It is particularly this work that led Uerpmann to be seen as the leading figure in German zooarchaeology and as one of the leading voices of international zooarchaeology. This characterization is warranted, since the other German scholars working on faunal remains from archaeological contexts invariably came from backgrounds in zoology, paleontology or veterinary medicine. They usually lacked knowledge of archaeology and did not view themselves as archaeologists. This also applies to the long and rich tradition of researchers on archaeological faunas in central Europe, who worked on many questions related to past subsistence practices, paleoenvironments, taphonomy, and animal domestication. Prior to Uerpmann's work the terms zooarchaeology and archaeozoology did not exist in Germany, and nowhere in German speaking Europe were archaeologist trained to analyze animal bones.

Given Hans-Peter's standing in the field, it came as no surprise that he was one of the founding members of the International Council for Archaeozoology (ICAZ) at the UISPP meeting at Nice in 1976 and that he continues to shape this leading organization until the present.

Hans-Peter played a central role in three special research centres (SFBs) funded by the German Research Council in Tübingen. These included the renowned *Tübinger Atlas des Vorderen Orients (TAVO)*, another SFB on paleoecology and one on climate coupled processes. In each of these and in many other contexts, Hans-Peter's research addressed the ways environmental and climatic change helped to shape human history.

Although Hans-Peter's research led him to travel widely, he often worked locally in central Europe on all periods from the Paleolithic to

the medieval period. This being said, extreme settings interested him the most. This explains his long commitment to research in Arabia. In this arid region, the slightest environmental change had the potential to shift the tentative equilibrium between nature and the human societies that had found ways of inhabiting this vast region. This interest led Hans-Peter, who was often accompanied by Margarethe and his sons Bjorn and Urs and daughter Adelina to places including Oman, and the UAE. Since 1996 Hans-Peter has excavated every year in Emirate of Sharjah. This work has documented a vast cemetery of early nomadic herders from the 6th and 5th millennium BC in Jebel al-Buhais and what is probably the best evidence for Paleolithic occupations in southern Arabia at Jebel Faya. One point that the work in Sharjah makes clear is that Hans-Peter is not 'only' a zooarchaeologist, but in every sense an archaeologist skilled at running and publishing major excavations. In fact over the years, it has become clear to me that colleagues, who pigeon-hole Hans-Peter as a specialist in zooarchaeology are often unaware of his many contributions to archaeology as a whole.

Another aspect of Hans-Peter's work was his willingness to embrace new methods and new technologies. He was always interested in having fast computers and excellent computer programs. If necessary he was happy to write software himself to obtain his goals. He also actively supported all kinds of research using stable isotopes and biomolecules. He was always quick to recognise the importance of new methods and, while still supporting the goals and teaching the methods of traditional zooarchaeology, he often seemed more interested in testing the limits of experimental methods. On many occasions, Hans-Peter made it clear to me that he had no objection to our using our small number of job-lines for hiring researchers working on stable isotopes, paleogenetics or other new fields. Often, I found myself as the younger member of our partnership being more cautious or skeptical of new methods than my senior colleague, who always wanted to work on the cutting edge of research using new methods.

I will not present the many contributions that Hans-Peter Uerpmann made to zooarchaeology and archaeology in general here. This would take too much space, and it might even be taken to imply that one does not have to read his publications. The contrary is true. Students of archaeology should read his publications more than they do. His prose is characterised by a concise, crisp logic and an economy that makes it a model of scientific style in both senses of the word. Hans-Peter's greatest strengths are his clarity of thought and his skill in explaining his observations. These aspects of his writing make his

papers, regardless whether they were written in German or English a pleasure to read and to reflect upon.

A teacher's legacy is usually defined by the work of his students. Since I have been in Tübingen Hans-Peter has contributed to the training of scores of students. His teaching evaluations were always remarkably favorable and in recent years one could notice an affinity between him and his many students that was much like that between a grandfather and his grandchildren. Students instinctively knew that they could trust him, and he was often an advocate for the causes of the students. He would take on this role with such grace that solutions to nearly every problem could be found, without anyone losing face or being compromised in his or her position.

Hans-Peter trained students in all periods from the Lower Paleolithic to Middle Ages on topics that ranged from all aspects of traditional archaeology to the newest and at times experimental methods of zooarchaeology. Hans-Peter trusted his students and let them work in peace. His students trusted Hans-Peter to be there when he was needed and to help with all matters of science. Dozens of Hans-Peter's students are active in the field in Germany, but also in England, Japan, Turkey, Syria and Armenia.

Aside from his formal teaching of students in Tübingen, or as a guest professor at the University of Alaska, Harvard, MIT, or Kyoto, I often heard from colleagues, that they had learned ideas or techniques from Hans-Peter. This certainly applies to me. Since Hans-Peter never followed a cookbook in teaching or in research new ideas arose constantly and one always learned from him. Often I heard praise of Hans-Peter's teaching coming from unexpected places, and I am sure that his influence is greater than most people and indeed Hans-Peter himself knows. Unlike many academics, who just go through the motions of routine activities, behind his facade of calm and mature wisdom Hans-Peter was always developing and testing ideas.

Regardless of what came and went in the field, Hans-Peter never got caught up in the changing scientific fashion of the day. Instead he was his own man in matters of science. I think it is ultimately this characteristic that gave him his credibility and made him one of the great minds in zooarchaeology as well as in the other areas of archaeology in which he conducted his research. It is entirely fitting that this volume be dedicated to him.

The contribution of François Poplin to Archaeozoological studies

Christine Lefèvre

In December 1980, at the beginning of one of his bachelor's degree classes at the University Paris 1 Panthéon-Sorbonne, François Poplin asked the students if someone would be interested in going to Corsica the following summer, to help a PhD student of his preparing cow skeletons for a local comparative anatomy collection. My brain selectively registered 'Corsica' and 'summer', with visions crossing my eyes of beautiful beaches and hot sunny days (remember this was December in Paris ...). Thus, at the end of the class, I found the courage to approach him and tell him that I would be interested in the job. François Poplin asked me if I had cleaned a skeleton before and if I knew how to do it. After my negative answer, he invited me to come to the Museum the next Saturday, where I boiled and cleaned my first bison skeleton.



In July 1981, I indeed spent a month in Corsica, cleaning eight cows (and unfortunately also burning a fox!) for Jean-Denis Vigne (who was the above mentioned 'PhD student' of François Poplin). We worked long days, the 'osteological lab' was in a dark basement, and when I came back to Paris, my mother's first words were: 'you look so tired and pale, my darling!' Well, I had learned not to confuse archaeological or osteological training courses with holidays!

That day in December 1980 marked my first visit to the Comparative Anatomy building of the Paris National Museum of Natural History. I was hooked: by the Museum, its collections, and of course by François Poplin's personage. After a very brief detour in a

Physical Anthropology laboratory for my Masters degree, I came back to the Museum in 1983 for my Doctoral research and obtained a permanent position there in 1989. I have been fortunate to spend all those years near François Poplin, to be a close witness of the birth and development of the research team he created and which now numbers over 60 scientists, and to benefit from his permanent intellectual ferment and creativeness.

François Poplin was born in Auxerre, Yonne, in 1943. Yonne is one of the four departments constituting the Burgundy region and being an 'Icaunais' (a native of Yonne) is a strong component of François Poplin's individuality. There lie his deep roots: his youth and school years, his father who was Professor of History, the family house in Auxerre, the Irancy wine, and a series of local figures whose names have passed into posterity with different degrees of fame. He has written some beautiful papers on topics related to this area, which, to some scholars, may seem marginal to his major research lines but are in fact splendid pieces of work showing the extraordinary knowledge of the man and his strong attachment to his countryside, and which, when one reads them with the rest of his oeuvre, are plainly part of his mental construction.

The Yonne department also hosts some archaeological sites which will definitively orientate his life. In 1955, the young François spent the summer holidays excavating at the site of Escolives, then directed by André Leroi-Gourhan. In 1958, he participated for the first time at the excavations at Arcy-sur-Cure. This encounter with the great Prehistorian was a decisive step: François Poplin learnt a lot from the man from whom he later said 'combien j'en ai reçu de culture'. Later in his career, he wrote several papers dedicated to André Leroi-Gourhan, analysing his perception of the animal world and its relation with men through time. In one of them, François Poplin narrates how, during the excavation he conducted at the beginning of the 1980s at La Roche au Loup, a Prehistoric cave near Merrysur-Yonne, he used to take young students unfamiliar with the region for a walk. During these expeditions in his old 2CV (which sometimes ended earlier than expected due to running out of gas!), he would focus their attention on the flora and soils of the slopes they were wandering through until he would reach a certain spot and have them turn around to discover the basilica of Vezelay on the eternal hill ... I was lucky enough to be one of these students and it was a moment in my life I will never forget.

Despite his interest for archaeology, François Poplin studied

veterinary medicine in Lyon, a safer way 'to earn his daily bread' and a good way to unite scientific research and animals. There, he had for teacher another great man, Professor Robert Barone. In a moving homage to his former professor, François Poplin dwelt on the clarity of his exposition and the importance of his 'perceiving the unity of nature as well as its diversity, which is richness'. Under his supervision, François Poplin completed in 1966 a Doctoral Thesis entitled *Research on the biometry of the ocular globe of domestic mammals*. Working as a veterinary doctor in the Berry region, François Poplin did not renounce his interest in Palaeontology and Archaeology and entered the University of Paris 6 Pierre and Marie Curie, where he studied Palaeontology and defended in 1972 a Doctoral Thesis entitled *Contribution to the morphology and biometry of Alopex lagopus (Linné) and Vulpes vulpes (Linné). The foxes of Arcy-sur-Cure*.

This double education gave François Poplin a very special dual vision and approach: the animal alive, with which he has a sensitive, empirical relation, and its skeleton, witness of the past and of the relationship between human beings and animals.

In 1972, François Poplin was hired at the Laboratoire d'Anatomie comparée of the Paris Muséum national d'Histoire naturelle, owing to the kindness of Professor Jean Antony. Created in 1793, the Chair of Animal's Anatomy was first directed by Jean-Claude Mertrud, then, from 1802, by Georges Cuvier. The name of Comparative Anatomy was given by Henri Ducrotay de Blainville who succeeded Cuvier in 1832. When François Poplin arrived in the place, he was the only one interested in 'old bones', prehistory, or archaeology. The epoch was more favourable to new techniques such as genetics, and the rich osteological collections assembled by Buffon, Daubenton, Cuvier and many other more anonymous collectors, and hosted in Comparative Anatomy, were suffering from a lack of interest: money was short, and so were the curatorial staff. Aware of the richness and importance of such a tool for archaeozoology, François Poplin spent long lonely hours in the dark basement of the building, inventorying skeletons, employing his anatomical skills to reconstruct mixed up specimens and re-identifying what he called (and we still use the term ...) 'lost children'.

During these early years at the Laboratoire d'Anatomie comparée, François Poplin's research was dedicated to numerous studies of faunal assemblages from Palaeolithic, Neolithic, Iron Age sites. These works are far from being simple quantified lists of bones. As he had learnt alongside André Leroi-Gourhan, François Poplin always questioned the significance of the bones in the sites, never forgetting

that the assemblages are the results of human actions, and advocating for the 'palethnological interpretation of animal remains'. He also published some avant-garde and fundamental works on quantification methods or taphonomy, still used by young French archaeozoologist beginners, but which were unfortunately ignored by most non-French-speaking archaeozoologists.

Shortly after 1972, a few students and young colleagues started to gather around François Poplin. They would come with a box of bones to identify, asking for advice, looking for comparative specimens, and finding in François Poplin an attentive interlocutor, eager to transmit his deeply interdisciplinary approach to the next generation. Their names were Patrice Méniel, Jean-Denis Vigne, Sophie Beckouche, Frédérique Audoin-Rouzeau, Joëlle Pichon ... Some of them are probably familiar to readers.

The 1970s were also a time period during which archaeozoology took an expanding place in archaeological studies, among the French as well as in the international community. In 1976, at the meeting of the Union internationale des sciences préhistoriques et protohistoriques (UISPP) held in Nice, the creation of the International Council for Archaeozoology (ICAZ) was decided and François Poplin was among its first members. In August 2010, Jean-Denis Vigne and myself were extremely happy and proud not only to co-organise with other colleagues the 11th ICAZ International Conference in Paris, but above all to have François Poplin as President of the Honour Committee. Afterwards, when he expressed to me how much he had enjoyed the event and told me that this was the best homage we could pay to him, all the efforts we had put into the preparation of the Conference were rewarded.

The 1980s see increasing activity for François Poplin and the growing group of young archaeozoologists around him. In 1982, the proposal of the creation of the Cooperative Research Program 'Animal, os et archéologie' (RCP 717) was granted by the French National Centre for Scientific Research (CNRS). The financial support and scientific recognition helped the still quite informal group in equipping the archaeozoological laboratory, participating in field work, travelling to study material, attending conferences, and so forth.

At the same time, François Poplin's intellectual process kept progressing toward Anthropolzoology, questioning the relations between human beings and animals not only through bones but also through bestiaries, texts, languages ... In 1983, an informal meeting of seventeen French 'archaeologists specializing in bones' was organised

by François Poplin and the RCP 717 at Avallon (Yonne), and hosted by Thérèse Poulain, the first 'faunal archaeologist' hired at the CNRS in the early '60s. The group pointed out and regretted the lack of links with other researchers interested by the relationships between men and animals, such as historians, anthropologists, philologists, veterinarian doctors, zoologists... It was decided to create the international association 'L'Homme et l'animal, société de recherche interdisciplinaire' (HASRI) and to launch a new journal, *Anthropozoologica*. Starting modestly, the journal took a new step in 1990, with the setting up of an international referee committee and the support of the CNRS. It is now published by the Scientific Publications of the French National Museum of Natural History and distributed in many countries through exchanges with the Central Library of the MNHN. François Poplin is still an active member of the referee committee.

In 1990, another stage of recognition was reached for François Poplin's team, with the creation of a true CNRS-MNHN Research Unit, the URA 1415 'Animal, os et archéologie'. In the meantime, several members of the original core obtained permanent positions either at the CNRS or the MNHN, others chose different paths, and newcomers joined the group. François Poplin directed the group for 12 years, until J.-D. Vigne took over the direction in 2002. The names of the team have fluctuated at the whim of the quadrennial contracts with the CNRS, the group has expanded, the research topics have been recently enlarged to archaeobotany but the spirit and goals have remained the same: documenting the history of human societies through their relationships with animals and plants.

1990 also marked the creation of a new Master programme specialization called 'Environment and Archaeology', accepted by the MNHN and various French universities. François Poplin took an active part in the organisation of this programme, which was aimed at developing the interface between human and natural sciences for the benefit of archaeology and in which he taught for many years. He had taught at the University of Paris 1 Panthéon-Sorbonne since the early '70s but as his research moved on from archaeozoology to anthropozoology, François Poplin felt the need to organise a seminar in which scholars and researchers from various disciplines could share their common interest in the history of the relationship between human beings and animals. In 1994, he thus launched a series of seminars on the 'Natural and cultural history of true animals' at the National Museum of Natural History. The seminar has become a regular rendezvous and each session is an occasion of personal

enrichment.

During those years, François Poplin kept writing numerous papers. I do not intend to present a detailed and exhaustive analysis of his many contributions to a wide range of topics. I would rather let people consult his publications list available on the website of our team and encourage them to read them. Some will argue that most of the titles are in French: yes, indeed, but what French! The style is remarkable, each word carefully chosen to fit at best the author's mind and extract and reveal its various meanings. The studies of animal remains become less directly present in his oeuvre, but bones, teeth, shells, hair, feathers, scales, milk and even wood, seeds and stones are never very far away. His natural and cultural approach is nourished by the synthesis between those material signs of animals and their appearances in texts, languages, bestiaries, and art. The analysis of animal remains becomes the means to go back to the thought and mind of long gone human societies and not only to their material life. From Anatomy to Palaeontology and Prehistory, François Poplin's work spreads to History, Ethnology, Anthropology, from Archaeozoology to Anthropozoology. Long before the fusion of our group of archaeozoologists with a group of archaeobotanists, François Poplin did not ignore the vegetal world, and included some of them in his works on animal and vegetal cultural history.

Perhaps more easily accessible to the archaeological community are François Poplin's works on ivory and other hard materials of animal origins. His incredible skills in recognising both the anatomical and taxonomic substances are fascinating. He travelled extensively to visit numerous collections and museums, (re)identifying substances, explaining the techniques used to create the objects from a piece of tooth or tusk. The Louvre Museum has appealed to his expertise many times, and his name should have appeared as the main author of the catalogue of the 2004 exhibit on *Ivories, from Ancient Orient to Modern Times*, as well as on numerous museum exhibit cards. The biogeographical implications of the presence of objects in certain places at certain times have formed the basis of profoundly valuable papers on the movements of people and animals in the past.

François Poplin is definitively an atypical researcher, teacher, and colleague. Although it is sometimes difficult to follow his extraordinary intellectual brilliance and his 'Encyclopedist' culture, he has been and still is a great inspirer of ideas. He is an unremitting worker and shows the same enthusiasm today as in the past, even for lesser discoveries. In that, he is still a model for the youngest and the less young scientists of our lab. He played a major role in our

community in promoting a global naturalistic and anthropological approach to the relationships between men and animals. Retired since December 2008, he remains the Honorary Director of our research group and is Honorary Attaché of the National Museum of Natural History.

Beyond the researcher and the great mind, there is also a man who can reveal a great kindness and goodness. His very special take on the *Art of Being a Grandfather* delights the numerous little daughters and sons of the lab staff who sometimes wander in the corridor where he has his office: they know that the big book is in fact a candy box, and that François Poplin is always willing to open it for them!

Part 1

Palaeolithic and Neolithic subsistence in northern Mesopotamia, Anatolia and the Iranian Plateau

1. Small game and shifting subsistence patterns from the Upper Palaeolithic to the Natufian at Baaz Rockshelter, Syria

Hannes Napierala, Andrew W. Kandel and Nicholas J. Conard

A joint research programme based at the universities of Munich and Tübingen focuses on primary animal domestication in the Upper Euphrates Basin. To gain a better understanding of the onset of the Neolithic, the project also examines the preceding Palaeolithic of neighbouring regions. This approach affords a fuller picture of variability among faunal accumulations in hunter/gatherer contexts and allows us to explore the changes that occurred as the Neolithic began. We studied four Palaeolithic sites in southwestern Syria: Baaz Rockshelter, Kaus Kozah Cave, Ain Dabbour Cave and Wadi Mushkuna Rockshelter. These sites are situated in the central Levant in the foothills of the Anti-Lebanon Mountains 40-60 km northeast of Damascus.

Here we presents results from Baaz Rockshelter with its especially well preserved stratigraphic sequence beginning with an Early Upper Palaeolithic horizon, followed by Late Upper Palaeolithic, Natufian and Pottery Neolithic layers. In addition to the many parallels with supra-regional trends, the Natufian faunal assemblage also shows clear differences compared to the southern Levant, a region which shows higher percentages of wild sheep and hare. Shifting relative abundances of these species can be interpreted as a result of either changed human subsistence behaviour, or as a mere consequence of environmental parameters. In order to differentiate the osteomorphology, we developed new criteria during the course of the study. The identification of two different species of

gazelle among the material is noteworthy. The occurrence of both Gazella gazella and G. subgutturosa reflects the location of the site in an ecologically transitional area.

Keywords Subsistence patterns, Baaz rockshelter, Syria, Palaeolithic, Natufian

Introduction

Baaz Rockshelter is an archaeological site located in the foothills of the Anti-Lebanon Mountains in southwestern Syria about 40km northeast of Damascus. The site is a small rockshelter situated at the base of the limestone cliffs that rim the al-Majar Depression (Figs 1.1 & 1.2). During our numerous systematic surveys in the area, many sites in a similar topographic position were recorded. However, sites with stratified deposits like those found at Baaz were the exception.

Excavations carried out between 1999 and 2004 by a German-Syrian team under the direction of Nicholas J. Conard from the University of Tübingen identified seven archaeological horizons (AH) of deposits spanning from the Early Upper Palaeolithic (EUP) to the Neolithic period. The bottom of the sequence, AH VII, is EUP and dates to ca. 33ka BP (Conard 2000). While no dates are available from AH VI, AH V dates to the Late Upper Palaeolithic with an age of ca. 22ka BP. Richest in finds are the upper layers AH III to I, whose assemblages are mostly of Late Natufian age (ca. 11ka BP) (Table 1.1).

AH III proved to be especially noteworthy, containing a built-in stone mortar and a constructed hearth surrounded by the remains of a circular house structure with a packed clay floor (Stahlschmidt 2010). Only AH I contains some intrusive younger material. Nonetheless, the majority of finds from AH I appear to be of Natufian age, as suggested by the lithics (Hillgruber 2010) and botanical remains (Deckers *et al.* 2009). The finds in AH I span a wide interval, with an array of artefacts ranging from Khiamian points, which typologically date to ca. 10ka BP, and transverse arrowheads, which fit well with the youngest radiocarbon dates of 5241 ± 35 and 5707 ± 34 BP. AH I also contains a small number of ceramic fragments (Conard 2000).

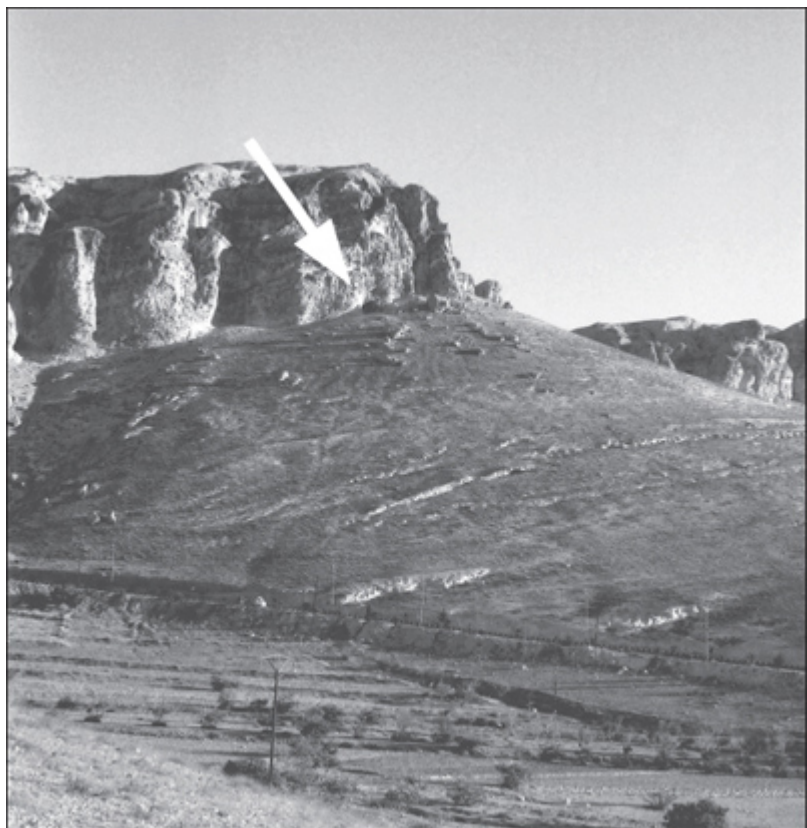


Fig. 1.1. Baaz Rockshelter. View of the limestone cliffs from the cliff slope below. The white arrow indicates the site (Photograph by A.W. Kandel).

Table 1.1. Radiocarbon dates for the Baaz Rockshelter.

<i>Lab Code</i>	<i>AH</i>	<i>uncal BP</i>	<i>cal BP</i>
KIA-11580	Ia	5241±35	6020±70
KIA-11579	II	5707±34	6500±50
KIA-11578	II	10,667±97	12,650±80
KIA-11577	III	10,942±65	12,860±80
KIA-11576	IIIa	10,470±121	12,380±210
KIA-30307	V.1	21,310+740/-680	25,630±970
KIA-30308	V.1	23,040+270/-260	27,670±400
KIA-30310	VII	32,060+600/-560	36,500±1070
KIA-30309	VII	34,200+1460/-1240	38,750±1920

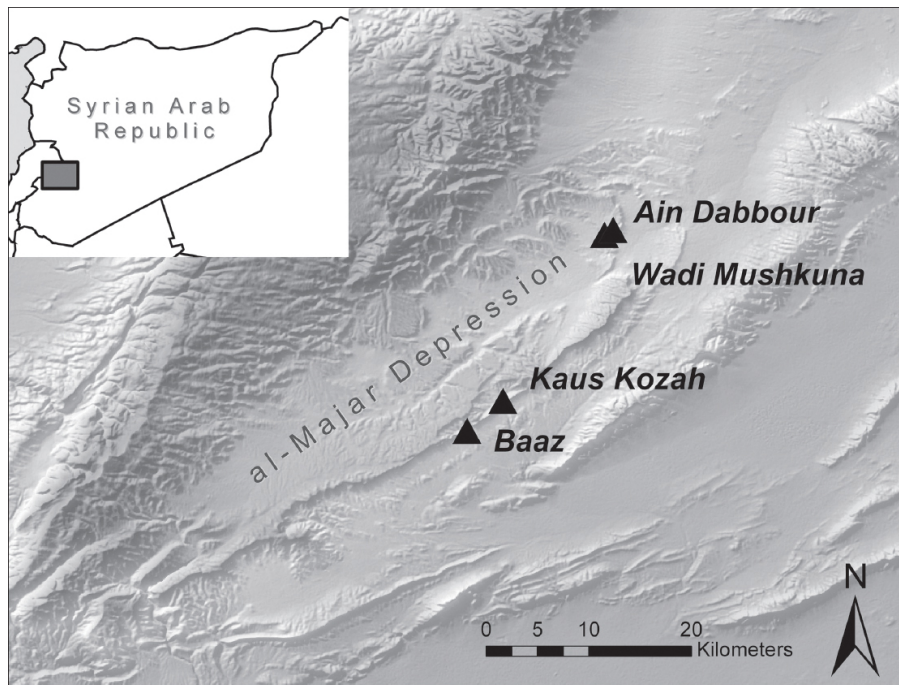


Fig. 1.2. Baaz Rockshelter. Sites and features mentioned in the text.

The faunal assemblages from Baaz are interesting in many respects (Napierala 2011). Above all, the long chronology of the deposits offers the opportunity to test ideas about the shift in subsistence strategies from the Upper Palaeolithic (UP) to the Epipalaeolithic (EP). Small species, such as hare and tortoise, are usually much more numerous in EP assemblages of the Levant. This trend towards the exploitation of small animals is often interpreted as an indication of dietary stress on EP people (e.g. Cohen 1977). Stiner and Munro (2002) use the relative proportions of hare and tortoise as a scale to reflect the degree of stress. In this paper we discuss these hypotheses with regard to our findings at Baaz Rockshelter.

Among the EP complexes, the Natufian in particular shows a set of economic innovations, such as the extensive exploitation of wild grains and a broadening prey spectrum (Flannery 1969). This set of innovations is often seen as a key process that culminated in the domestication of plants and animals a few centuries later.

Baaz is located in the central Levant in an area that has not received much attention despite its proximity to the famous Palaeolithic sites of Yabroud excavated by Alfred Rust (1950) in the 1930s and Ralph and Rose Solecki (1966) in the 1960s. The Natufian occupation at Baaz narrows the geographic gap between Mureybet, Dederiyeh and other

EP sites of the northern Levant and what Bar-Yosef (1998) called the Natufian “homeland” of the southern Levant. Other interesting research questions include the zoogeography of equids and gazelles and palaeoenvironmental aspects, themes that will not be addressed in this article.

Some remarks on methodology

Reliable data about small game can only be obtained from assemblages that have been sieved during excavation, otherwise many small finds will be missed. At Baaz, sieving with 5mm and 1mm screens increased the number of small finds considerably, especially the fraction of small game. Therefore, our assemblage allows us to test existing hypotheses about small game proportions on a thoroughly and meticulously excavated collection. The total number of identified small game finds is 1544, including the finds from sieving. If we only look at the individually piece-plotted, small game finds (i.e., excluding sieved finds), the number of identified specimens (NISP) for small game is 374. By comparing the unsieved and sieved fractions of the assemblage, we can observe shifts in the relative proportions of game categories. If we examine just the unsieved, identified, piece-plotted finds, 297 large game finds are present compared to 374 small game finds, yielding a 4:5 ratio. However, if we add the sieved fraction, the ratio rises to 1:2 (770:1544), tipping the ratio more strongly in favour of the small species. The weight ratio for large to small fauna without the sieved fraction is 830g:351g (5:2) and 1159g:626g (2:1) with it. This observation indicates that investigators may have underestimated the small game fraction in older excavations where detailed screening of the material was not undertaken. It is interesting to note that the bias is not as strong when weights are compared, because sieving usually yields smaller and lighter fragments.

All faunal remains were not only counted, but also weighed to improve the comparability of find quantities between layers and to those of other sites. This is helpful because preservation varies considerably between layers and sites. In the Natufian layers of Baaz (AHs I–III), most bones of gazelle and larger animals were broken apart by salt and gypsum, while those of hare and tortoise were not. Therefore, counting the fragments would have favoured the larger animals simply because they are more fragmented. In the UP AHs IV–VII, bone preservation was better for the larger pieces, and no destruction by salt crystal growth was visible. Thus, a comparison between the UP and Natufian layers on the basis of NISP is not very informative, because it is greatly affected by taphonomic agents. The

weight of a bone, however, stays the same, no matter how many pieces it is broken up into. At some point, of course, the fragments will no longer be identifiable, but this is a statistical bias that exists for every quantification of finds. Another advantage of weighing bones is that the larger and heavier bones of big animals are given more statistical relevance in questions regarding human subsistence. Since larger animals produce more meat than smaller ones, an equal number (NISP) of bones from hare and onager does not indicate a similar economic importance of both species. Despite these advantages with regard to questions of subsistence, bone weight is not commonly used in zooarchaeology. Instead, MNIs and MAUs are calculated, which possess no linear relation to sample size, and are therefore problematic for comparisons of economic signals between different layers and sites. Thus for completeness, both bone weights and NISPs³ are given.

Small game exploitation at Baaz and the transition from Upper to Epipalaeolithic times

Dividing species into categories such as small or big game is a delicate task: while some species are clearly game, others could have found their way naturally into the cave, as is the case for many small carnivores, rodents and birds. Large carnivores are also problematic because they could have been hunted for their pelts or carried into the cave as “trophy” from further away, and should not be considered as game in the strict sense. “Small” is also a relative term that might mean something different in South America than in Africa, so that a clear definition is necessary for a specific research question. Munro (2003) defines small game in the Levant as “non-carnivorous animals weighing less than five kilograms that were hunted and consumed by humans.” This excludes the majority of problematic cases, with the sole remaining difficulty being the decision of which small species were human prey. Some small animals are large enough to be used as a source of meat, e.g. hedgehogs (Erinaceinae), pikas (*Ochotona*) and mole rats (*Spalax*). In fact, the bones of the latter are sometimes even burned, but this does not necessarily indicate human consumption. For the purpose of this article, these species are ignored, as are the birds of prey and the corvids, which are all debatable human prey. Fortunately, these examples do not make up a significant portion of the assemblage, especially when quantified by weight. Nor do they alter the results concerning changes in subsistence. This is the case at Baaz, where gazelle, wild caprines, equids, hare and tortoise represent the dominant species in both weight and number of finds. All of these

species show anthropogenic modifications, indicating that they were preyed upon by the occupants of the site. In summary, the small game fraction includes hare (*Lepus europaeus*), tortoise (*Testudo graeca*), partridge (*Alectoris chukar*), quail (*Coturnix coturnix*), single bones from sandgrouse (*Pterocles*) and goose (*Anser*) and several fishes.⁴

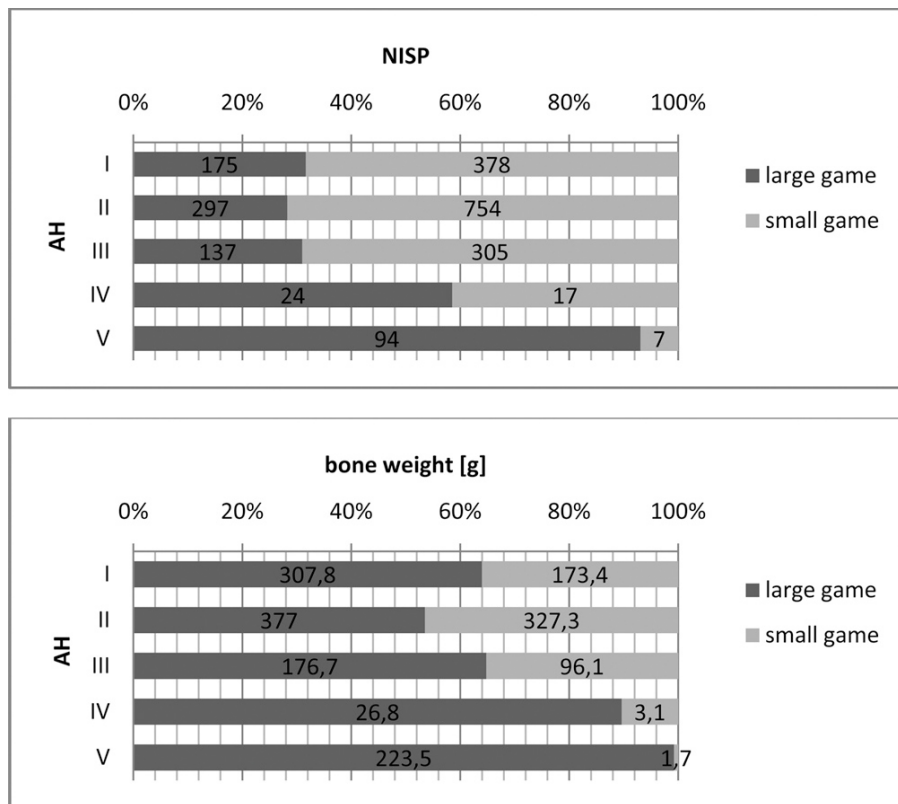


Fig 1.3. Baaz Rockshelter. Relative proportions of small and large game categories, by NISP (above) and weight (below), including the sieved fraction. Absolute values are also shown.

In all, 16,638 faunal finds from Baaz Rockshelter were analysed, with a total weight of 5152g. Of these, 2391 animal remains with a weight of 2044g were identifiable, which is an identification rate of 14% by NISP and 40% by weight. A total of 1544 faunal remains were classified as small game, almost three-quarters of which are hare by NISP ($n=1129$, $\Sigma=469g$.)

AH V–I provided enough data for the analysis of subsistence patterns (Fig. 1.3), although AH IV is relatively low in finds. In the UP AH V, small game makes up only a very small portion, slowly increasing in AH IV. The small game values are highest in AH III–AH I, showing a slight increase from AH III to II. This trend is reflected in

both weight and NISP, with the only difference being that the increase from AH III to II is more pronounced in the quantification of weight. The great number of small game in AH I is consistent with our hypothesis that the majority of finds from this layer are also of Natufian age. Small game birds and fishes occur only in the three upper layers, an observation that is also in line with a broadening prey spectrum from UP to EP times.

While a high percentage of NISP for small game does not necessarily indicate its economic importance, the relatively high percentage of bone weight does just that, because for mammals, the weight of bones is proportionate to the weight of edible soft tissue (Uerpmann 1972). Tortoise biases this approach somewhat, because the relationship between bone weight and live weight is relatively stable only for wild mammals, where bone weight comprises on average 7% of live weight (Kubasiewicz 1956; Uerpmann 1972). Still it is quite surprising that the small game species, with their tiny and light bone fragments seldom weighing more than a tenth of a gram, amount to about 40% of the total weight of all identified wild animal remains in the upper layers! The pattern of increased small game exploitation in the EP, and especially the Natufian, is therefore very evident at Baaz Rockshelter, confirming a shift in subsistence strategies from the Upper Palaeolithic to Epipalaeolithic. There is, however, no consensus on how this shift should be interpreted.

It is interesting to note that these altered subsistence patterns are observable not only in the large Natufian settlements of the southern Levant, but are now confirmed in more remote regions such as our research area in the central Levant. In southwestern Syria, population density (and consequently resource stress) was probably never as high as in the south and near the coastline, where Natufian sites are larger and more numerous. In Munro's (2004) terms, occupational intensity (i.e., the number of human hours spent at Baaz) was lower because fewer people inhabited the site per unit time. Therefore, the shifting prey spectrum at Baaz cannot be explained by population pressure triggering the necessity to expand the dietary basis (Stiner *et al.* 2000). To suspect a "food crisis" (Cohen 1977) as the driving force behind the Natufian innovation is unlikely with regard to Baaz.

In the southern Levant, Stiner and Munro (2002) used the "small game index" to estimate the occupational intensity of several sites. Their assumption is that fast moving game is more costly in terms of energy investment than slow moving game. Thus, a high proportion of slow moving tortoises is seen as an indication of low occupational

intensity and little resource stress, because tortoises are thought to be easy prey and therefore desirable. If occupational intensity, and the need for food increases, the tortoise population will be overexploited, and people will have to shift to faster moving game that is more energy intensive to hunt.

The ranking of prey species according to their benefits for the predator is a concept well known in biology. The mathematical models used to predict prey choice aim to “maximize the net rate of energy or mass intake” (Lacher *et al.* 1982), which is simply the ratio of energy intake divided by time spent. Concerning humans, however, we consider these assumptions too simple because the benefit is reduced to the energy balance of a hunt. Similarly, Stiner and Munro rank human prey species following predator-defence mechanisms (Stiner *et al.* 2000) or cost-of-capture (Munro 2004), both of which translate into a simple classification of slow versus fast moving species (Munro 2003; 2004). Yet for humans, the decision to select or reject a prey species is more complex than with other predators. For example, Stiner and Munro do not consider the quality of prey. If hare meat is considered more valuable, hunters would have shifted to tortoise only if there was a need to do so, for example if they needed the carapace as a container, or if no hare could be found. The fact is that parts of animals were used to make personal ornamentation (e.g. Hayonim Cave, see Belfer-Cohen 1988), such as perforated teeth, bone pendants and beads, and in some cases, must have had ritual meaning (Grosman *et al.* 2008), raising questions about what motivated the choice of prey. We cannot expect that humans sought only to maximize their energy intake. They may also have tried to maximize prestige and social status and to fulfil non-dietary cultural needs.

Moreover, the maximum speed an animal is able to run is no measure of its “catchability” (Stiner & Munro 2002) because humans do not try to outrun their prey. Rather, the cautiousness and flight distance of an animal are often important factors. A hare will stay where it is, as long as it thinks that it has not been discovered. In this way, hares can often be approached within less than five meters (Napierala, personal observation)⁵. The same applies for the flight distance of wild sheep and goat. These animals rely on their climbing abilities to withdraw from a potential threat and can therefore be approached closer in rugged terrain. Palaeolithic hunters were most probably stalkers who learned to take advantage of these patterns of animal behaviour.

Gazelles, for example, are capable of outrunning every predator but the cheetah (Estes 1991: 70) and are very cautious animals with a

high flight distance. For the gazelles of Saudi Arabia (*Gazella subgutturosa*, *G. gazella*, *G. saudiya*), flight distances are reported to be more than one kilometre (Thouless *et al.* 1991). For the Thomson's gazelle (*Eudorcas thomsoni*) in Africa, the common flight distances are 50–300m from leopards and 300–1500m from cheetahs and pack hunters such as hyenas (Estes 1991: 75). Gazelles can therefore generally be expected to be difficult for humans to hunt. Yet despite these difficulties, gazelle is one of the most frequent species in Natufian assemblages and is common even at Middle Palaeolithic sites. As most animals in arid environments are attracted by surface water, predators often wait for gazelles at waterholes (Heptner & Naumov 1966: 546), a technique that could have similarly been employed by human hunters. Technological innovations could have played a role with regard to the increase in gazelle in archaeological materials towards the EP. Changes in lithic technology towards small, retouched forms support the hypothesis of major changes in subsistence technology. Technological innovations, such as refined projectile weapons, nets and traps, are mentioned by Stiner and Munro (2002), but ignored because they overestimate the energy investment in the production and curation of these tools. If this were the case, these inventions would never have established themselves in hunter and gatherer contexts.

Coming back to Baaz, our findings contradict the hypothesis towards the “small game index”. Hare is always the dominant small game at Baaz, both by weight and by NISP (Fig. 1.4), which speaks for a relatively high resource stress and occupational intensity, according to Stiner and Munro (2002). Only under such conditions would hunter-gatherers exploit presumably low-ranked resources like hare. Although the packed clay floor and the hearth and mortar show a significant degree of settlement activities (Stahlschmidt 2010), in terms of occupational intensity, Baaz can definitively not be compared to large sites like Hayonim (Stiner 2005), where tortoise represents a much higher proportion than in the Late Natufian deposits at Baaz.

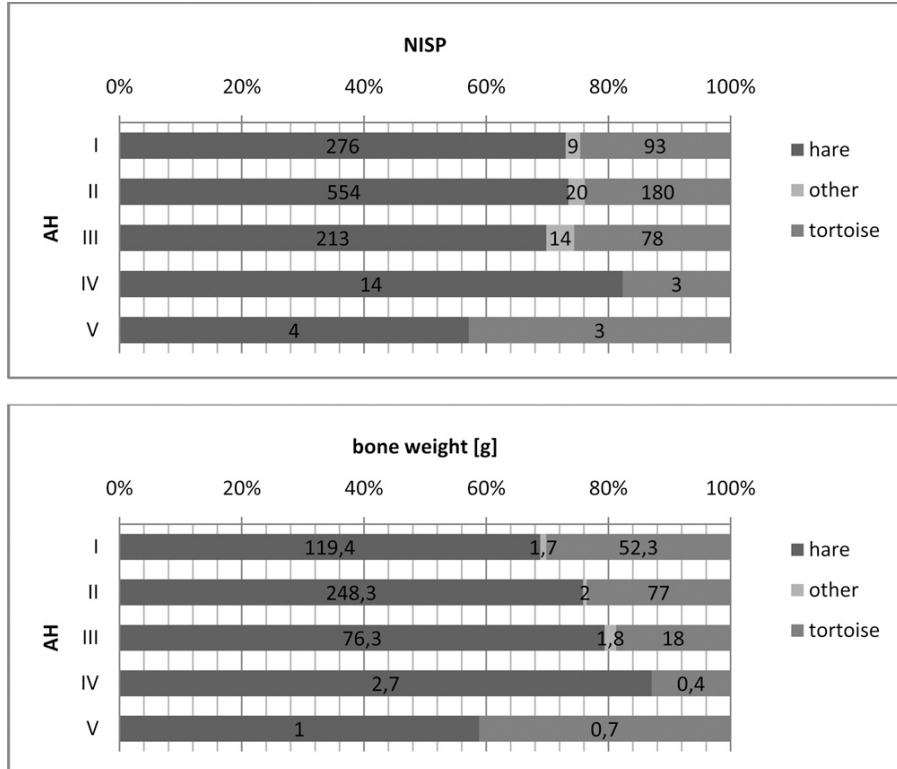


Fig. 1.4. Baaz Rockshelter. Relative proportions of the small game species⁷ by NISP (above) and weight (below).

The cave site of Hilazon Tachtit also demonstrates that tortoise has a meaning in Natufian ritual contexts and must not always be considered game in the nutritional sense. At Hilazon Tachtit, a female burial, possibly a shaman, is associated with a large number of tortoise carapaces and several bones from rare animal species, such as leopard and eagle (Grosman *et al.* 2008). At sites where both ritual and settlement activities occurred, such as at Hayonim, it is difficult to discern which tortoises reflect which activity. In such cases, the small game index will not produce an easily interpretable result because the non-dietary, cultural bias of Natufian economic necessities is difficult to assess.

To date, no burials have been observed at Baaz that would disturb the stratigraphy and perhaps contribute a portion of finds from such contexts. Still, uncertainty exists as to whether some carapaces were used as bowls. A number of finds show an outer surface covered in soot (Fig. 1.5) indicating that the carapace was placed upside down in a fire. If a large portion of the material was considered to be artefactual, the quantitative interpretation would become problematic,

because the respective amounts of each species would not be related to diet.⁶

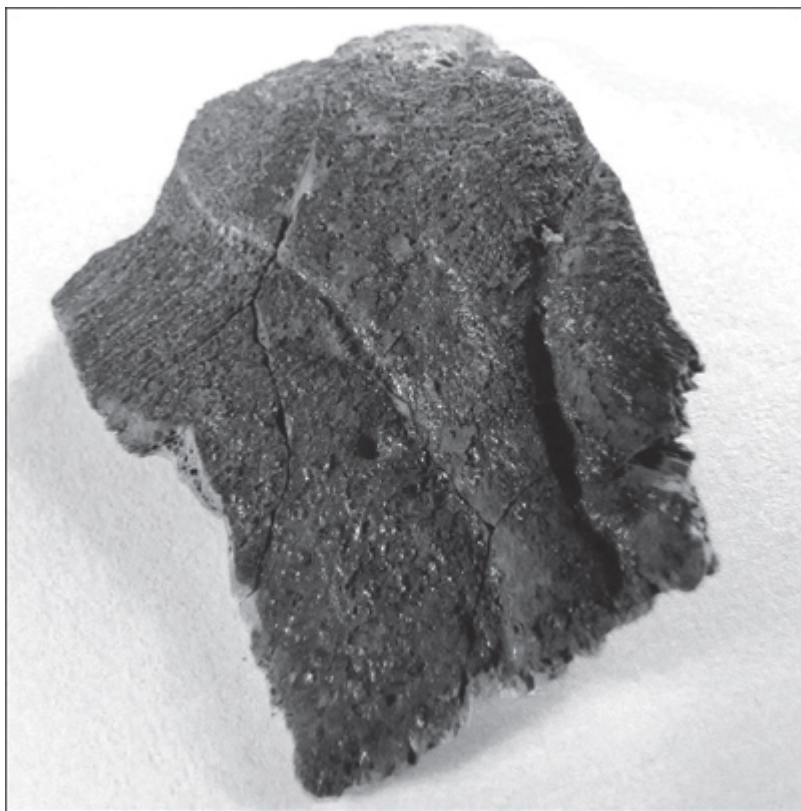


Fig. 1.5. Baaz Rockshelter. A fragment of a tortoise carapace showing a shiny, black, sooty outer surface. The interior is unburned. This appearance suggests that the whole shell could have been used as a “cooking vessel”.

If we examine bone weight, the ratios between tortoise and hare show a slight trend towards more tortoises within Layers III–I. Looking at NISP though, ratios are relatively stable, indicating a higher fragmentation towards the surface. Here it is important to add, that the identifiability of tortoise remains is high, even when they are highly fragmented.

Whether the observed decrease in the weight of hare is a reliable indicator of human behaviour rather than a taphonomic coincidence will be evaluated in the future, using data from micromorphology, geochemical analysis of bones and the study of three-dimensional find distributions.

A trend is also visible in the proportion of wild sheep vs. gazelle, with gazelle becoming more abundant moving up the stratigraphic column from AH III to AH I. This could well be explained by an

increased or prolonged occupation of the site, with graver consequences of hunting pressure on the more sedentary wild sheep. The observed parallel increase of gazelles and tortoises is inconsistent with Stiner and Munro's interpretation of the small game index.

Conclusion

The zooarchaeological data from Baaz support the observation that clear economic shifts took place from the Late UP into the Natufian with unprecedented amounts of hare and tortoise in the latter assemblage and a prey spectrum that includes birds and fishes. The findings at Baaz question the approach of ranking small game species by speed of movement, and therefore of linking the quantitative relationship of small game categories with a degree of resource stress and occupational intensity, as suggested by Stiner and Munro (2002) and Munro (2003; 2004). Furthermore, we do not support the idea that the strong increase in small game towards the Natufian was triggered by the necessity of humans to enlarge their dietary basis (Cohen 1977). Rather, we suggest that environmental changes and technological innovations played a major role, and we suggest that these key developments preceded population growth.

Our future work will focus on the Geometric Kebaran site Ain Dabbour Cave and on the Khiamian occupation of Kaus Kozah Cave. These assemblages will help us specify the exact time and extent of changes in the economy of early societies in the region and see how they develop towards the early PPNA at Kaus Kozah Cave. Furthermore, the well preserved faunal remains from the Middle Palaeolithic site Wadi Mushkuna Rockshelter will lengthen the chronology of subsistence patterns in our research area. Whether or not these observed patterns will confirm supra-regional trends remains to be seen.

Acknowledgments

We owe many thanks to the TDASP teams that were involved in the excavation of the site and the Syrian General Directorate of Antiquities and Museums, namely Bassam Jamous, Michel Maqdissi, Mahmoud Hamoud and Sultan Muhesen. For financial support of the excavation, we thank the Heidelberg Academy of Sciences and Humanities and the University of Tübingen. The faunal analysis of Baaz was financed by the German Science Foundation (DFG) and we thank our colleagues in the DFG project, "Ungulate domestication and early animal husbandry in the Upper Euphrates Basin", especially Joris Peters and Hans-Peter Uerpmann for their constant support and

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Notes

- 1 We regard finds as “identified” if at least the subfamily was determined for mammals and birds, or the family for fishes. Due to high fragmentation, a large quantity of finds could only be classified as “small or medium-sized ruminant” (gazelle, caprine, cervid) and fall into the “unidentified” class.
- 2 The definition of small game is discussed later in the text.
- 3 For simplicity, NISPs are indicated in the following text as n-values, while weights will be signified through the E-symbol.
- 4 see Napierala *et al.* (2013)
- 5 This behaviour is well known among modern hunters, so that it is considered unethical to shoot a hare in the shallow depression where it hides (e.g. Diezel & Müller-Using 1962).
- 6 For this reason, bone artefacts should generally be excluded from calculations with regard to subsistence behaviour.
- 7 The category “other” summarises the finds from the bird genres *Alectoris*, *Coturnix*, *Anser* and *Pterocles* and the fish families Salmonidae and Cyprinidae.

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2. Instability and co-development of the exploitation of early domestic sheep and goats: the example of Shillourokambos (Cyprus, Pre-Pottery Neolithic, 10,400–9000 cal BP)

Jean-Denis Vigne, Isabelle Carrère and Jean Guilaine

*Early domestic sheep and goats appeared in the middle of the 11th millennium cal BP¹ in the Near East. The final results of the faunal analyses from the Cypriot site of Shillourokambos (Parekklisha, Limassol; 10,400–9000 cal BP) provide original and precise information about how sheep and goats have been controlled, then herded, during the two millennia following their domestication. Here we briefly present the analytical results which are further detailed in the monographic publication. Goats are attested from the earliest occupation of the site in the form of animals which were significantly smaller than their wild ancestors (*Capra aegagrus*) from southeastern Anatolia, therefore probably domesticated before the transportation to the island. The evidence, including sexes and ages at death, indicates that goat populations lived in the wild (i.e. feral) and were exploited by hunting throughout the Early phases (i.e. until ca. 9500 cal BP). Conversely sheep appeared only during the course of the Early phases (ca. 10,000 cal BP) in the form of domestic animals (modified horn cores and small size) that were intensively bred for milk and meat starting from their arrival. In the middle of the 10th millennium, sheep however significantly decreased in size towards the end of the Early phases: possibly due to the collapse of the flock. Subsequently, at the turn of the mid-10th millennium (Middle phases), several strands of evidence suggest that the local feral goats had*

been domesticated and then bred for the production of milk. At the same time much larger sheep were abruptly introduced to the site (coming from Central or South Levant?) to be intensively bred for meat, and later for their hair. This succession of rapidly changing events, with both local recompositions of the system of exploitation, and external influences came from, probably, the nearby continent. This provides us with an original illustration of both the process of feralisation and subsequent local re-domestication, with delayed morphological modifications (goat), and of the complementarities of sheep and goats in the breeding system from as early as the 10th millennium BP.

Keywords Archaeozoology, Early Domestication, Near East, Cyprus, Sheep (*Ovis*), Goat (*Capra*)

Introduction

Evidence accumulated during the last decade, on the early domestication of small ungulates in the Near East, illustrates both the large variety of situations and heuristic importance of Cyprus island.

The earliest attestation of domestic sheep (*Ovis aries*) and goats (*Capra hircus*) (i.e. modified with reference to their wild ancestor) has been found in the high Euphrates Valley (southeast Anatolia) dated to ca. 10,500 cal BC. Comparing the Log Size Index (LSI) in the successive phases of Göbekli Tepe, Nevalı Çori and Gürçütepe, covering a period comprised between the end of the 12th millenium BP (PPNA) and the end of the 10th millenium BP (Late PPNB), Peters *et al.* (2005), indicated a rapid size decrease for both taxa, yet no significant modification of the size of gazelles in the same time. In addition they demonstrated that this morphological modification took place around the same time as a drastic and lasting change in the culling pattern of sheep and goats; characterized by a significant increase of the slaughtering of sub-adults indicative of an already well managed stock. More recently Helmer (2008) at Cafer Höyük (High Euphrates area) and Hongo *et al.*, (2009) at Cayönü (high Tigris Valley) gave convincing evidence of the presence of domestic goats in South Eastern Anatolia from the middle of the 11th millenium BP.

For the Zagros area, based on dental age profiles and on combinations of osteometric and epiphyseal estimations of age and sex ratios, Zeder and Hesse (2000) and Zeder (2001; 2005) demonstrated that goats were still hunted in the Late Glacial sites at Shanidar C and D and at Asiab, but that they were herded at Ganj Dareh and Ali Kosh. New series of radiocarbon dating on these sites lead her to propose the beginning of the 10th millenium BP for the local beginning of goat

domestication, without size decrease, in this area. Zeder also demonstrated that domestic sheep were later imported from Anatolia: in the middle of the 10th millenium BP.

More recently Naderi *et al.* (2008) studied the genetic diversity of the modern bezoar goat (*Capra aegagrus*) analysing 473 samples, from a secure origin, collected over the whole distribution range of the species. Namely they found a signature from an ancient (before 10,000 BP) population expansion in the main lineages of bezoars which gave birth to the domestic lineages, yet the bezoar lineage, which gave no modern domestic lineages, does not show such a signature. They interpreted this observation as the consequence of an early domestication center on the Central Iranian Plateau (Yazd and Kerman Provinces) and the southern Zagros (Fars Province) possibly corresponding to the management of wild flocks. They also found a second domestication centre in eastern Anatolia, and possibly in northern and central Zagros, which is the likely origin of almost all domestic goats today. Finally they proposed that the wild lineages which gave birth to the modern domestic ones have had a significant demographic expansion before 10,000 BC. They suggest that bezoar goats had been managed/controlled in the wild over a very large area, from the Taurus to the centre of the Iranian plateau, before stock keeping and herding began in the Taurus area.

The idea that the domestication process of goats might have begun across a large area with their management/ control in the wild, before any morphological modifications, corresponds with suggestions made for the wild boar in eastern Anatolia by Redding (2005; see also Redding and Rosenberg, 1998; Rosenberg & Redding 1998; Rosenberg *et al.* 1998 and Ervynck *et al.* 2001) based on the archaeozoological data from Hallan Çemi. The latter has recently been strengthened by Vigne *et al.* (2009) who demonstrated that the wild boar having been introduced overseas to Cyprus, before 11,700–11,400 cal BP, gave birth to dwarf island suids which then played the role of game for the pioneer Neolithic islanders, and which were most probably locally domesticated later on (Vigne *et al.* 2011).

This last observation emphasises the importance of Cyprus as a place from which the complex processes of early ungulate domestication in the Near East can be analysed with a peculiar accuracy. This is partly due to the fact that the island has never been connected to the continent, and that therefore the native (i.e. Late Glacial) Cypriot fauna was lacking any of the wild ancestors of the domestic ungulates (Boekschoten & Sondaar 1972; Simmons 1999): namely the wild mouflon (*Ovis orientalis*) and the bezoar goat (*Capra*

aegagrus). According to Davis (1984) followed by Vigne *et al.* (2000; 2003) early suids, bovids and caprines on Cyprus had been introduced to the island, at the very least, as managed/controlled animals and at the most as domesticates. Conversely, Horwitz *et al.* (2004) proposed that they have been introduced as wild animals, for providing living resources of meat.

The importance of Cyprus in this research is also due to the fact that the human societies, which frequented or lived on the island during the process of neolithisation, were fully involved in it, and therefore they were able to reflect various aspects of this process in the Near East continental areas. The earliest known step in the Prehistory of Cyprus is dated to 12,000 BP at only one site (Akrotiki-Aetokremnos; Simmons 1999; see also Ammerman & Noller 2005; Ammerman *et al.* 2006; Vigne *et al.* 2009) and pre-dates the Neolithic times. The Early Pre-Pottery Neolithic period is now documented at several sites and is dated to between 10,400 and 9000 BP (Guilaine & Le Brun 2003; Peltenburgh & Wasse 2004; Guilaine & Briois 2007) followed by the Aceramic period of the Khirokitia phase. The gap between the Pre-Neolithic and Pre-Pottery Neolithic phases (from 12,000 to 10,400 BP) is now decreasing with recent discoveries by McCartney *et al.* (2008) at Aya Varvara-Asprekremnos, and with our own discoveries at Ayios Tychonas-Throumbovounos and Ayios Tychonas-Klimonas (Guilaine & Briois 2007; Vigne *et al.* 2012).

This paper aims to contribute to understanding the process of the domestication of sheep and goats in the Levant, from the early step of management/control in the wild to full herding of morphologically modified caprines, through the results of the archaeozoological analyses of the large Cypriot Pre-Pottery Neolithic site at Shillourokambos (Parekklisha, Limassol). It is an open field site located on the coastal plain at the confluence of two small and shallow valleys. The excavations were conducted over ca. 10,000 m² under the direction of one of the authors (J.G.) from 1992 to 2004. Together with more than 50 radiocarbon dates they have evidenced four chronological phases: Early A (10,400–10,000 BP), Early B (9900–9600 BP), Middle (ca. 9500 BP) and Late phases (9500–9000 BP). These phases are represented in diverse ways over the two main sections of the site. The first section is very eroded but rich in numerous wells, pits and poles holes, most of them dating to the Early phases. The third section being much better preserved with numerous rests of buildings mainly corresponding to the Middle and Late phases. The final study of the first section of the site has provided an improved and refined chronology of the occupations with the

discovery of additional phases (Early C for the end of early B; Middle A1, Middle A2 and Middle B in the Middle phase).

This new chronological framework has enabled the completion of the final archaeozoological study (Guilaine *et al.* 2011), and added numerous original data to that of the preliminary studies (Vigne *et al.* 2000; 2003; Vigne & Guilaine 2004). Ten mammal species have been recognised, all of them being absent from the Cypriot Pleistocene records, most likely having been introduced to the island by humans during the late Pleistocene (Vigne 1999; Vigne *et al.* 2000). Pigs, goats, cattle, cats, mice, and dogs, are attested in the Early A phase suggesting that, at least, some of them were already present on the island before that time. However only pigs are actually attested in the Pre-Neolithic sites at Aetokremnos, Asprokremnos and Klimonas (Vigne *et al.* 2012), and the Mesopotamian fallow deer, foxes and sheep only appear with the Early B phase ca. 10,000 BP. Detailed analyses of the ca. 32,500 animal bones from the first section of Shillourokambos (including 9225 determinates) are presented in Guilaine *et al.* (2011), while a summary of the results which have been obtained for sheep and goats is detailed below.

Material and methods

As there are almost no carnivores at the Pre-Pottery Cypriot sites (Davis 2003; Vigne & Guilaine 2004) the bone remains at Shillourokambos are very well preserved: especially the articular extremities. The first section of Shillourokambos provided 2433 specimens of Caprinae with 35% of them being identified as sheep or goats, according to the criteria of Boessneck *et al.* (1964) for the post-cranial skeletons, and Payne (1985), Helmer (2000), Halstead *et al.* (2002) and Balasse & Ambrose (2005) for the cheek teeth. Sheep and goat gave exactly the same number of bones (NISP=420). The proportion of sheep and goat bones was only 10% in the Early A phase, 20–25% in the other Early and Middle phases yet dominated the two last phases (Middle B and Late).

After a very strict, critical review of their chronostratigraphic origin we selected 394 adult bones for goat and 378 for sheep. Respectively they provided 1284 and 1378 measurements recorded according to von den Driesch (1974). LSI were calculated and used with respect to the recommendations, after Meadow (1999), Zeder (2005) and Vigne *et al.* (2005). In particular, in order to reduce the bias due to allometries, Anova and pairwise Tukey's distances and probabilities (with correction of Bonferroni) were systematically processed by comparing the LSI coming from the different anatomic parts; the

measurements with a frequency of distribution which was significantly divergent from most of the data, were excluded from the LSI calculation. Statistical comparisons have been processed with Past (PAlaeontological STatistics, ver. 1.43; Ryan *et al.* 1995).

Based on the bone measurements the sex ratios and the mean size of each sex were estimated by the probability and by the mean of the two groups obtained from mixture analyses (Monchot 2000; Monchot & Lechelle 2002). The sexual dimorphism, one of the earliest morphological modifications in the process of domestication (Arbuckle 2005), was quantified by the difference between the mean sizes of male and female as estimated by the mixture analyses.

Epiphyseal ages were estimated according to Silver (1969) while dental ages at death were estimated according to Payne (1973; 1987) and Helmer (1996), and processed according to the references and techniques after Vigne and Helmer (2007). Because the different age profile models actually cannot always be distinguished with classical statistical techniques (Vigne 2000; Marom & Bar-Oz 2009) we used multivariate correspondence analyses (CA; Vigne 2000; Helmer *et al.* 2007) which compare the mortality profiles in terms of their main tendencies, taking into account the actual sample sizes. CA were processed with Spad (Cisia Ceresta ver. 4.01).

Goats

As already mentioned, and illustrated in Vigne *et al.* (2000), the morphology of the goat horn cores from the Early phases of Shillourokambos did not differ from those of the bezoar goats. [Figure 2.1](#) evidences that the average LSI did not vary significantly at all during the chronology of Shillourokambos (Anova: $F=1.854$, $df=7/339$, $p=0.076$). Contrary to what we proposed in the preliminary analyses (Vigne *et al.* 2000; 2003) the comparison of the final metrical results against the early and middle phases of Cafer Höyük (northern Levant; Helmer 2008), suggests that the Pre-Pottery Neolithic Cypriot goats were slightly, but significantly, smaller than the bezoar goats. This cannot be explained by a long stay in the wild on the island because there are no goat bones from the 239 determinate bones at Klimonas (Vigne *et al.* 2012) nor at any of the Cypriot sites which pre-date Shillourokambos. This rather suggests that the goats, introduced to Cyprus shortly before (or at) the beginning of the occupation of Shillourokambos, were already domesticated on the mainland.

Comparing the goat LSI from the main phases of Shillourokambos, against those of Aswad-Damascus (Helmer & Gourichon 2008;

unpublished) and Tell Halula (Saña Seguí 1999), emphasised that the Cypriot goats did not followed the size decrease that is visible on the mainland through the Middle and Late PPNB, due to the intensification of domestication (Fig. 2.1).

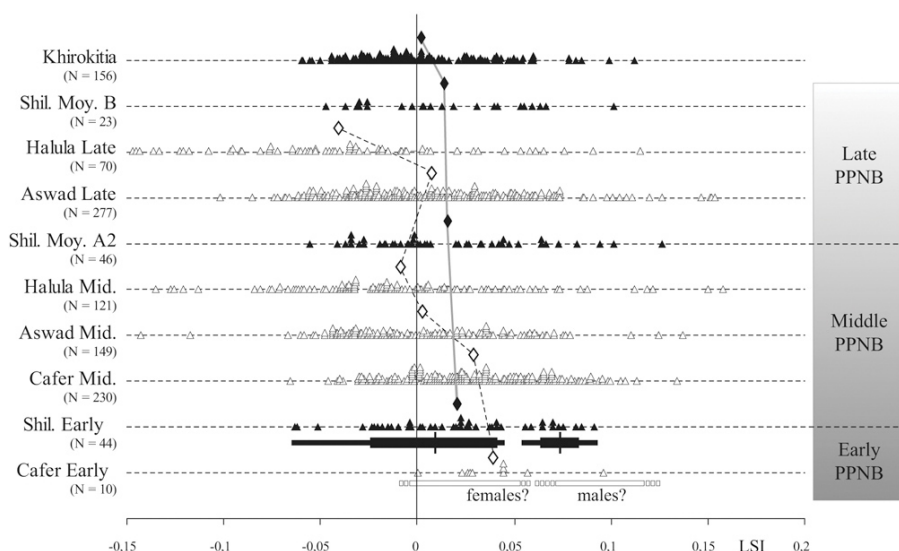


Fig. 2.1. Comparison of the distribution of the goat LSI of Khirokitia (according to Davis 1994; 2003; unpublished) and of the different chronological phases of Shillourokambos (solid symbols) with various other sites of the north Levant (empty symbols; according to Helmer 2008; Helmer & Gourichon 2008; unpublished; Saña Seguí 1999). Diamonds indicate the mean of each of the series. The intervals of variation of females and males for Shillourokambos Early phases are those calculated by the mixture analyses; for Cafer they have been drawn freehand.

As shown by two examples (Fig. 2.2A) the frequency distribution of most of the goat measurements significantly fit bimodal distribution models, and can be interpreted as the expression of a strong sexual dimorphism. LSI's also significantly fit bimodal distribution models for each of the phases (Fig. 2.1). This permitted the study of the evolution of the sex ratio, of the mean size of females, of the mean size of males and of sexual dimorphism through the entire chronological sequence of Shillourokambos (Fig. 2.2B). Owing to the numerous measurements taken by Davis (1984; 1989; 1994 and unpublished), from the Aceramic Neolithic site at Khirokitia, this study could be prolonged up to the 9th millenium BP. We observed that the size of females was not subjected to any significant modification except a decrease after the Middle A phase ($z=3.6$, $p=.0005$). The male size also decreased at the very end of the chronological sequence ($z=4.0$, $p=.0001$) in such

quantities that the sexual dimorphism also decreased. In the Late phases a new type of horn core appears: much smaller in size and with an oval basal section closer to that of the domestic than the bezoar type.

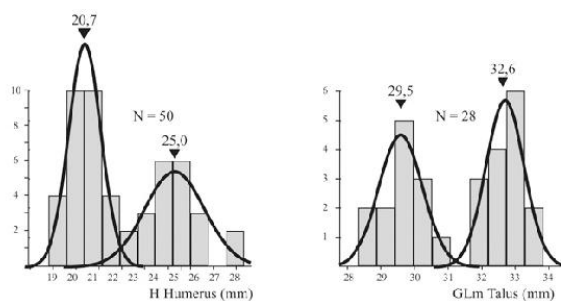
Figure 2.2C indicates that the sex-ratio of adults does not vary out of the 50/50 range during the Early phases. During the Middle A2 and B phases the proportion of males decreased so much that it became significantly different from 50% in some cases. At Khirokitia adult females were significantly dominant.

The CA of the culling profiles based on the tooth eruption and wear reveals important changes in the strategy of acquisition of goats throughout the site's occupation (Fig. 2.3). The three individuals of Early A phase died ca. 4–6 years old but the sample was too small to be included in the CA. The weak structure and the dominance of adults (class G) and old individuals (class H–I) in the Early B and C phases, together with the well balanced sex ratio, suggests hunting rather than herding or even control. The culling profile of the Middle A1 and A2 phases is much more selective, dominated by, and in the CA correlated to, the sub-adult classes C and D; the dominance of females in the above mixture analyses of the measurements of adult bones indicates that most of the latter were males. By contrast with the Early phases this suggests that these flocks were likely herded. At the end of the occupation of the site uncommonly high proportions of adult females, from classes E–F and G (with no H–I contrary to the Early phases), suggests a specialised milk exploitation of B type, according to Vigne and Helmer (2007); or any other use of adult animals (dung for agriculture, fibres, prestige).

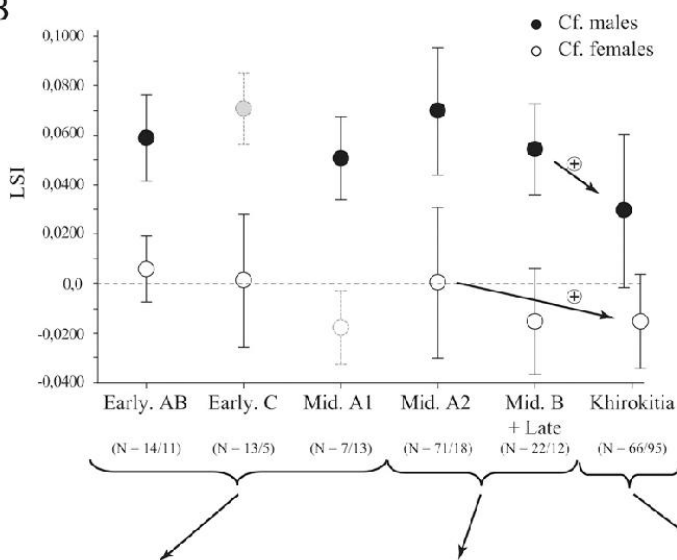
In conclusion, during the Early B and C phases (and probably also Early A) there were no morphological modifications of goat morphotypes being introduced to Cyprus shortly before the beginning of the occupation of Shillourokambos. The strategic acquisition of goats is poorly selective and focused on the most profitable individuals (i.e. adults and old males and females). It appears that the domesticated goat introduced to Cyprus must have first been released into the wild (feralisation) and then exploited by hunting. This scenario is slightly different than the introduction of wild goats which has been proposed by Horwitz *et al.* (2004) based only on preliminary results of Vigne *et al.* (2000). During the Middle phases there is clear evidence of management for meat production though without any detectable size decrease or horn core modifications. Less than three or four centuries later we observe significant size decrease of males and females; the sex ratio diminished and one specimen of modified horn

core appeared. These can be interpreted as a consequence of the intensification of control attested during the Middle A1 and A2 phases. Collectively this data describes a complete process of (re-)domestication of the feral goat introduced nearly one millennium before, and hunted until that time. At the end of the sequence, during the Middle B and Late phases, goat exploitation drastically shifted toward ante-mortem products, probably dairying.

A



B



C

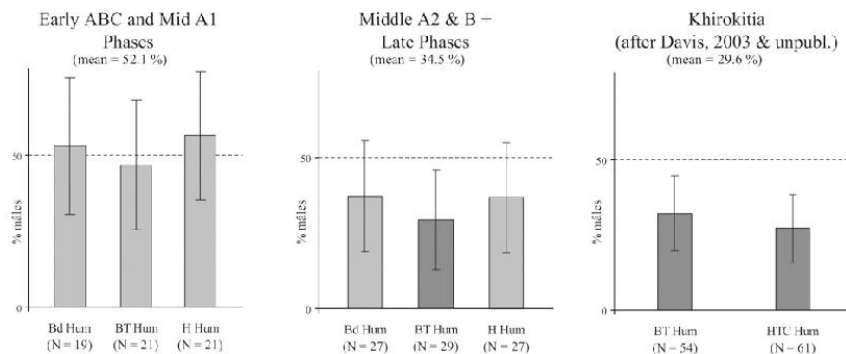


Fig. 2.2. Goat (*Capra hircus*): A: two examples of bimodal distribution of bone measurements of Shillourokambos (all phases are computed together) with the calculation of the corresponding bimodal model with the mean size of cf. males and cf. females; B: Evolution of mean size and 5% standard deviation of cf. males and cf. females over the different chronological phases of Shillourokambos and at Khirokitia (the latter after Davis unpublished) as estimated through the mixture analyses of the LSIs; grey dotted lines emphasize small samples; (+) indicate statistically significant decreases of the mean; C: Evolution of the sex ratios and 5% standard deviation over the different chronological phases of Shillourokambos and at Khirokitia (the latter after Davis unpublished) as estimated through the mixture analyses of three measurements of the humerus distal extremity; dark grey columns emphasise the proportions which significantly differ from 50% (z test > 1.96; 5% confidence).

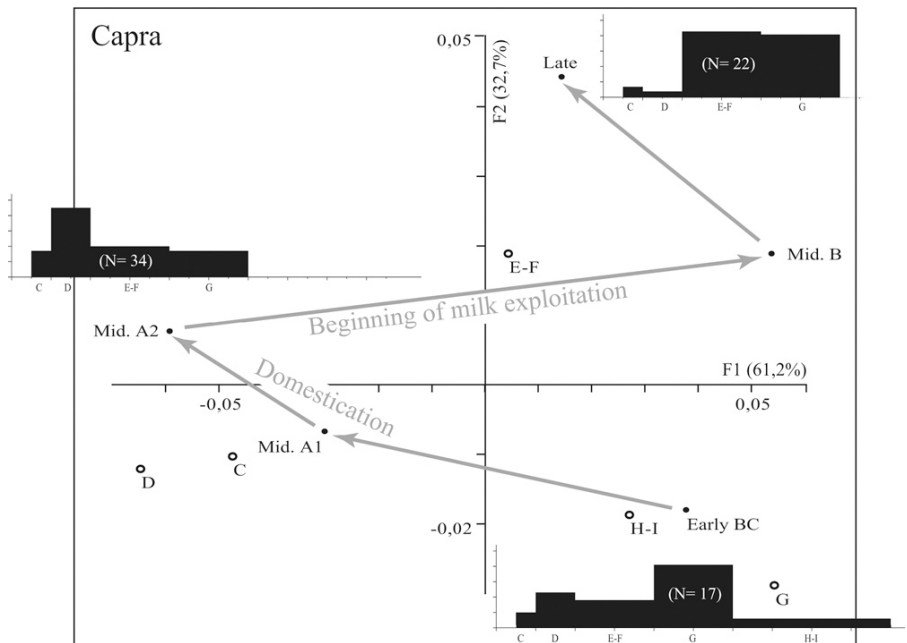


Fig. 2.3. Projection of the plan defined by the two first factors of the correspondence analysis of the culling profiles of goat of the different phases of the site occupation at Shillourokambos; interpretations are in grey.

Sheep

As already mentioned, and illustrated by Vigne *et al.* (2000; 2003), as early as sheep appeared in the Shillourokambos records (Early B

phase) horn cores from the rams showed a large variety of basal sections which differ from the *Ovis orientalis* wild type. The ewes horn cores were already much reduced in size, while two large skull portions in the Middle A2 phase showed no horn cores.

We have demonstrated elsewhere that the variations in the sex ratios, among our set of Cypriot and comparative metrical data, did not seriously bias the comparisons (Vigne in Guilaine *et al.* 2011, p. 1021 *et seq.*). Figure 2.4 indicates that sheep of the Early B and C phases of Shillourokambos were significantly smaller ($F=1.2$, $p=0.57$; t test=4.2, $p<.0000$) than the PPNA *Ovis orientalis* wild ancestors as measured at Myreybet (Gourichon & Helmer 2008), Jerf el-Ahmar (Helmer unpublished) and Göbekli (Peters unpublished), and do not differ from each other (pairwise t tests=1.8, 0.4 and 1.7; $p=0.08$, 0.71 and 0.08). Conversely they were either slightly smaller, or the same size as the Early or Middle PPNB domestic sheep as measured at Nevalı Çori (Peters unpublished), Dja'de (Gourichon & Helmer unpublished), Cafer (Helmer 2008) and Aswad (Helmer & Gourichon 2008). Together with the morphology of the horn cores these observations confirm that the morphotypes of sheep, which were introduced to Shillourokambos at the very beginning of the 10th millenium BP, were already deeply modified by several centuries of herding (Vigne *et al.* 2000; 2003).

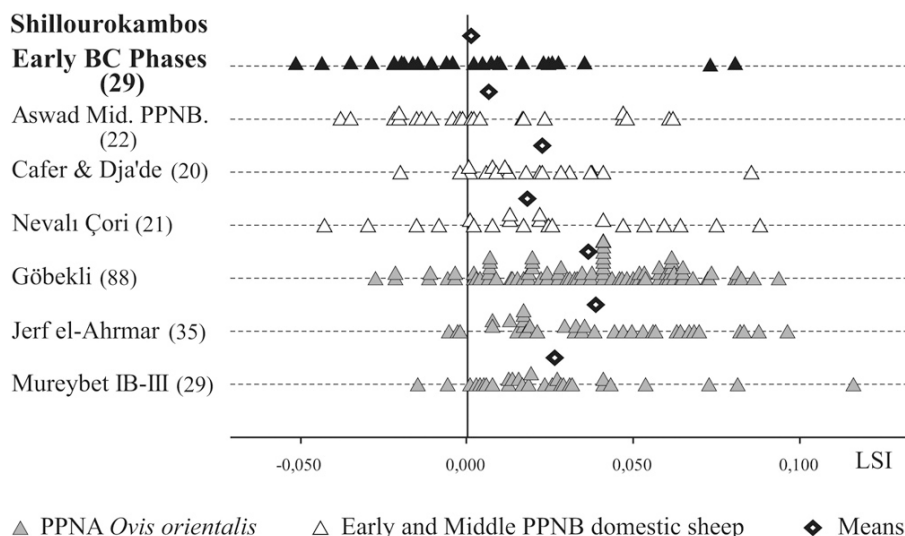


Fig. 2.4. Comparison of the size of sheep of the early B-C phases at Shillourokambos with those of the wild ancestor (*Ovis orientalis*) as illustrated by three PPNA sites in the Northern Levant, and with the ones of early domestic sheep in four other Early or Middle PPNB sites of the North (Nevalı Çori, Cafer and Dja'de) and Central (Aswad-Damascus) Levant.

See references in the text.

Though the sexual dimorphism is much lower, from sheep than from goats (Davis 2000), the series of LSI measurements at Shillourokambos were large enough to estimate sex ratios, separate mean sizes for females and males and sexual dimorphism through mixture analyses (Fig. 2.5A). Even some measurements of the humerus, talus or phalanges gave significant bimodal distributions: all of them evidence a very unbalanced sex ratio, with a high dominance of females among adults (Fig. 2.5B).

From Early B to Middle A1 phases of Shillourokambos sheep were subject to a significant decrease in size (Fig. 2.6; Welch t test for unequal variances = 2.93, $p=0.007$; permutation: $p=0.0086$) whilst at the same time the rate of hypoplasia on the horn cores increased. Suddenly during the transition between the Middle A1 and Middle A2 sub-phases these very small sheep were replaced by significantly larger ones (Welch t test = 3.2, $p=0.003$; permutation: $p=0.013$); the size of which did not change significantly in the rest of the sequence. At the same time horn cores appeared with a more flattened basal section which appears to be the same type described by Ducos (1968) at Khirokitia and for the Southern Levant. This strongly suggests that the Early phase lineages were replaced by a new type of sheep coming from elsewhere: possibly the Central or South Levant.

It is not clear if the sheep of the Late phase of Shillourokambos were slightly larger or similar to the early sheep at Khirokitia. It is however worth recalling that sheep were again subjected to a significant and rapid size increase between the 9th millennium Early (E–C) and Late (III–I) phases of occupation of the Khirokitia village (Davis, 1994; Fig. 2.6).

If we plot the size evolution of sheep at Shillourokambos against the general evolution of size in the northern and central Levant (Fig. 2.7A) we observe that the sheep of the Cypriot Early phases were the same size as the Middle PPNB Aswad sheep; the latter being significantly larger than those of the contemporaneous Middle Euphrates sheep at Halula (after Saña Seguí 1999). A study of the similarities of these variances (Fig. 2.7B) confirms that sheep from the Early phases of Shillourokambos were closely related to their counterparts at Aswad-Damascus. This is also true for the Middle phases (except, of course, the tiny sheep of Middle A1 phase) with reference to the Aswad Late PPNB. It seems that sheep decreased in size in the Middle Euphrates but that they did not in the Damascus area. These two introductions of sheep at Shillourokambos might have come from, as in the Early phase, Central or Southern Levant site

similar to Aswad-Damascus.

Factorial CA of the sheep culling profiles at Shillourokambos indicated important variations of the system of exploitation through time (Fig. 2.8). In the Early B and C phases a high proportion of B class (2–6 months), together with a high level of D class, evidenced a mixed milk and meat exploitation according to Vigne and Helmer (2007). From these estimations of the sex ratio we could conclude that males overwhelmed among those animals which were slaughtered in B, C and D classes. This kind of profile corresponds to a high level of control of herding techniques and of utilisation of the territories resources since it implies that, at least for part of the day, the young were driven separately from the ewes. During the Middle A1, A2 and B phases the CA emphasises a strong correlation of the profiles with D class, which are actually very dominant, and a drastic change with reference to the sophisticated mixed system of the Early phases. This selective slaughtering of sub-adult males (according to the above estimation of sex ratios) corresponds to a specialized meat exploitation with some animals (females?) however being kept alive until old age (reproduction, hair, dung?). The transition between the Middle and Late phases seems to have been marked by another important change of the system of exploitation: an increase in the proportion of eldest animals (class H–I). Besides meat exploitation this may have resulted from the emergence of the exploitation of ante-mortem produced, perhaps hair. However such an interpretation should be considered cautiously due to the mandibles dated to this phase coming from only one rubbish pit with a very specialized exploitation of sheep.

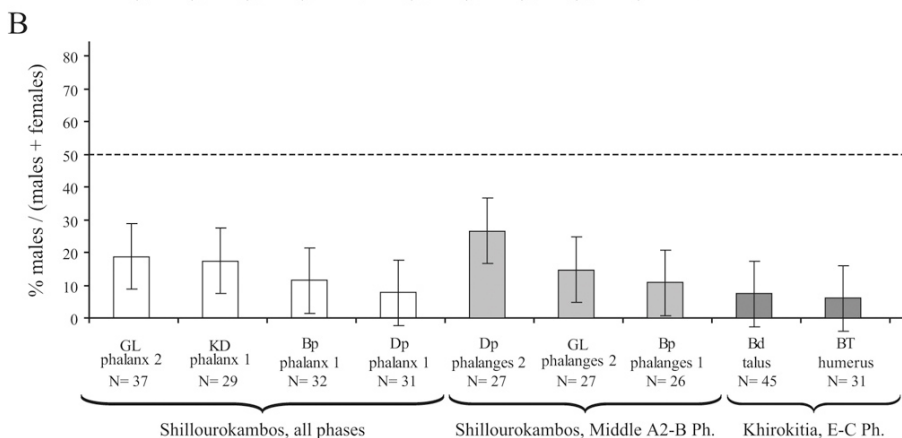
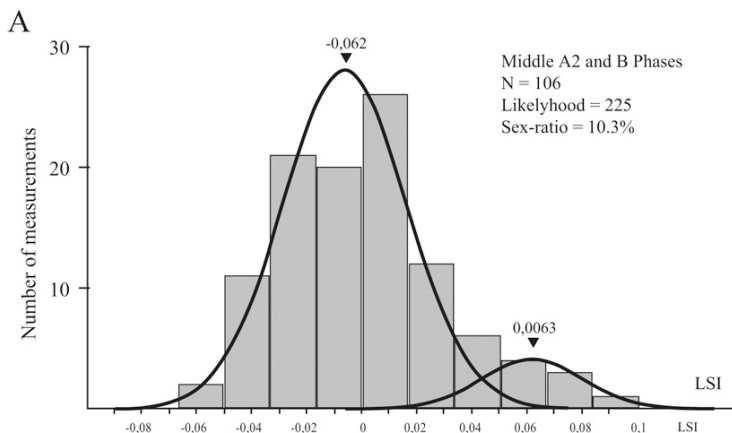


Fig. 2.5. A: Example (Middle A2 and B Phases) of a mixture analysis of the LSI of sheep of Shillourokambos; B: Estimation of the sheep sex-ratio and their 5% standard deviation based on the mixture analyses of various skeletal parts of different chronological phases at Shillourokambos and Khierokitia (latter after Davis 1994; unpublished).

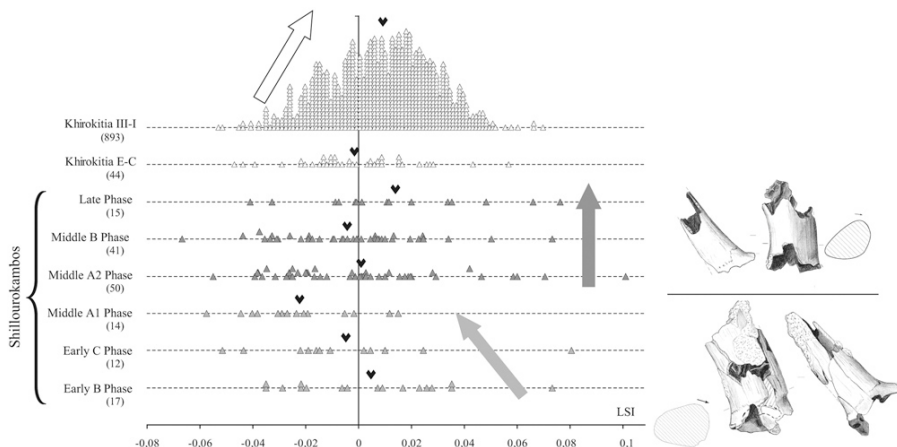


Fig. 2.6. Size and horn core evolution by sheep through the chronological sequence of Shillourokambos and at Khirokitia (the latter after Davis 1994; unpublished). Drawings: JDV.

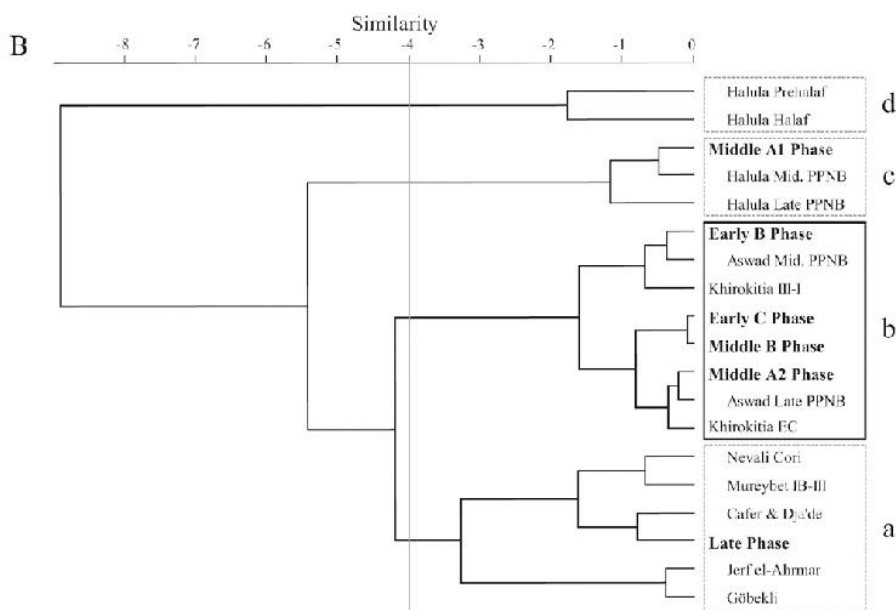
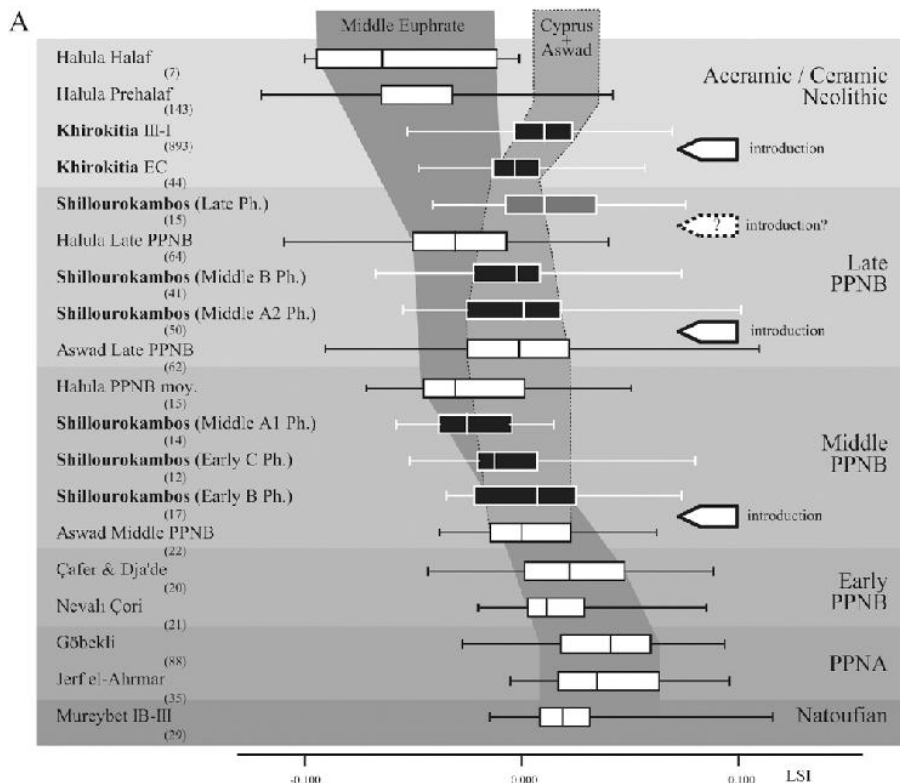


Fig. 2.7. Sheep: A: Evolution of the LSI in the different phases of Shillourokambos and of Khirrokitia (black) plotted together with the evolution of LSI in some reference sites of the Northern Levant (references

in the text); B: 'Dendrogram' of the hierarchical clustering of the similarities of the variances or the LSI's of the same assemblages, most of the phases of Shillourokambos cluster with Khirokitia and Aswad-Damascus.

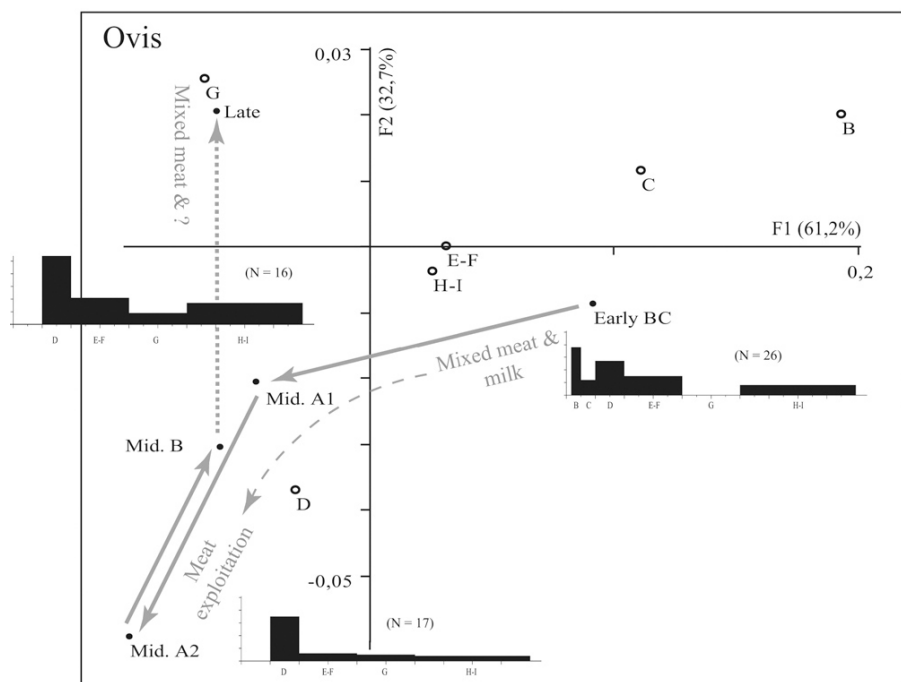


Fig. 2.8. Projection of the plan defined by the two first factors of the correspondence analysis of the culling profiles of sheep from the different phases of the occupation at Shillourokambos. In grey, interpretation.

Conclusive summary and comments

Our observations can therefore be summarised as follows:

- Goats were introduced to the island in the form of early domestic animals around the middle of the 11th millenium BP (Early PPNB); shortly after the earliest known attestations of domestic goats in southeastern Anatolia and shortly before, or at the earliest occupation of Shillourokambos.
- These recently introduced goats were released quickly into the wild; enabling the people of the Early phases at Shillourokambos to exploit the resulting feral populations through hunting.
- Starting from the early Middle phases the people began to domesticate some of the goats for meat exploitation culling selectively the sub-adult males. Significant size decrease and

further morphological modifications became visible only in the recent phases (i.e. 2–4 centuries later) when, at that time, goat exploitation has shifted towards milk. This is the first evidence of the domestication process from a Mediterranean island occurring one millennium later than the earliest attestation of domestic goat in the Northern Levant.

- Sheep were introduced to Shillourokambos (to Cyprus?) several centuries after the goat: from the beginning of the 10th millenium BP. Their morphology was that of fully domestic animals, very similar to those of the Middle PPNB sheep from the central (and south?) Levant, as represented at Tell Aswad-Damascus.
- They were immediately bred in a sophisticated way for both meat and milk production.
- Proceeding an episode of rapid size decrease and stress increase, possibly connected to breeding failure or even collapse, new larger size sheep were introduced again, possibly, from the Central or Southern Levant (or from another area of Cyprus; Vigne 2009).
- Then domestic sheep having been exploited for meat production during the later phases of Shillourokambos were perhaps, after a second introduction of a new lineage exploited for their hair also.
- Simon Davis (1994) already evidenced another event of very rapid size change between the early and the late levels at Khirokitia.
- There is no evidence at any time for sheep feralisation or hunting. The history of sheep at Shillourokambos appears to have been a succession of different kinds of herding; regularly strengthened by the introduction of new lineages which probably came from the mainland.

In brief, contrary to goats, sheep had not only been introduced to Shillourokambos rather late in the course of the occupation of the site, and in the form of modified domestic lineages, but had also been herded during the entirety of the sites occupation, while local lineages became replaced, several times, by allochthonous ones. The only common point with goats is that the strategies of exploitations of sheep have changed several times during the 10th millenium BP: illustrating the relative instability of the status of the system of exploitation of the early Neolithic times (Vigne *et al.* 2003; 2011; Vigne 2008).

We have already previously discussed these observations in the general context of the evolution of the technical and economic system of the site of Shillourokambos, and more widely in the context of the

Neolithisation of the Near East (Vigne *et al.* 2011). The implications of the process of domestication of the feral goat at Shillourokambos will also be discussed elsewhere in more detail (Vigne *et al.* in preparation). Here we will just limit our conclusions to four remarks.

It is finally not very surprising that goats were introduced early to Cyprus due to its early and widely spread management in the wild before true domestication. More surprising is the late arrival of sheep, which seem to have been domesticated, almost at the same times as goats in the Upper Euphrates Valley. This probably resulted from the fact that sheep and goats were not domesticated in exactly the same place, at the same time or for the same reason(s).

Obviously in the minds of the people who lived at Shillourokambos, over the early centuries of the 10th millenium BP, goats were game while sheep were the most domestic of all the ungulates (Vigne *et al.* 2011). This probably implicated very different symbolic values for each of them, at least, during the Early phases. Archaeozoology tends, too much, to mix these two species only because their bones are difficult to discriminate from each other. Here we have additional evidence that they are really very different from bio-ecological, techno-economic and symbolic points of view (see, for example, Balasse & Ambrose 2005).

Because of these differences the two species were able to play complementary roles in the techno-economic system. If the very rapid size decrease of sheep at Shillourokambos actually resulted from a failure of their breeding we could consider that the domestication of goats, which began approximately at that time, was developed to offset this failure.

Finally the complementarities between the two species is still more clearly illustrated by the end of the story: when goats took over from sheep for milk production sheep being then devoted to meat and, maybe, to hair.

Acknowledgements

We are grateful to Simon Davis, Lionel Gourichon, Daniel Helmer and Joris Peters who provided unpublished data for the Northern continental references. Jill Cucchi improved the English language, any remnant mistake being the responsibility of authors. The French School at Athens, French Ministry of Foreign Affairs, and Department of Antiquities of Cyprus greatly approved or helped our work in Cyprus.

Note

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3. The fauna of Tell Aswad (Damascus, Syria), early Neolithic levels. Comparison with northern and southern Levant sites

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The first occupation levels at Tell Aswad, a Neolithic site located in the central Levant near Damascus (Syria), dates to the end of the Early PPNB period. These architectural levels had yielded a low amount of faunal remains but their chronological position and the geographical location of the settlement make their study of great archaeozoological interest. The archaeological material found in these occupation levels shows affinities with both northern and southern Levant sites: for instance, the flint tools are rather southern-related in a typological point of view but the knapping technology produced northern-type supports. The study of the faunal remains provides also some similarities with both regions: importance of the hunting of small game and also presence of caprines since the oldest level.

The present study addresses two issues: 1) Ovis, Capra, Sus and Bos; were they domesticated at the beginning of the settlement? 2) How did these taxa take part in the particular dynamics of the northern and southern areas regarding the animal domestication? Different statistical methods – Principal Component Analysis (PCA), Log size index (LSI) and Mosimann's method – are here applied on the same biometric data in order to study the variations of the bone size as well as those of the shape.

According to the results obtained, sheep were domestic in the early levels and the status of the goats and pigs is also probably domestic. However, nothing can be asserted for the bovines because of the lack of measurements. The comparison with other regions shows different evolutions of the livestock. If it seems to have been acculturation from the

North, the adoption of some techniques was made in a way that was particular to the South.

Keywords Domestication, Pre-pottery Neolithic, *Bos*, *Sus*, *Capra*, *Ovis*, acculturation, Near East.

Introduction

Tell Aswad is a Neolithic tell located in the Damascene basin, 20km southeast of Damascus City (Syria). The settlement was discovered in 1966 and two sounding pits were first excavated in 1971 and 1972 (Contenson 1995). The recent excavations conducted by D. Stordeur and B. Jammous from 2001 to 2007 in the same areas reviewed the initial chronological attributions made by H. de Contenson and demonstrated that the so-called 'PPNA' phase ('Aswadian') corresponds actually to an Early PPNB horizon, i.e. to the end of the 9th millennium cal BC (Stordeur 2003a; 2003b; Stordeur & Jammous 2006). The whole occupation sequence at Tell Aswad, based on the excavations of the area B, was then subdivided as follows (Stordeur *et al.* 2006):

- 'Early' phase: levels B9 to B12 (late Early PPNB)
- 'Middle' phase: levels B1 to B8 (Middle PPNB)
- 'Late' phase: levels B-5 to B0 (late Middle PPNB and transition with the Late PPNB)
- 'Pottery' phase: level A (scattered pits dated to the Early Pottery Neolithic).

In the Neolithic times, the site was settled near the shore of one of the two permanent lakes (now seasonal) supplied by the Barada and Awaj rivers coming from the Anti-Lebanon Mountains. The village is surrounded by hilly landscape westwards and dry steppe areas in other directions.¹

The last archaeozoological study of Tell Asawad was based on the faunal assemblages found in the levels B-5 to B8 until 2005 (Helmer & Gourichon 2008). The main results indicate that cattle, goat, sheep and pig were domesticated in the MPPNB phase and that hunting played an important role in the subsistence economy, especially of small game. The presence of wild specimens was evidenced for the pigs and the goats, but not demonstrated for the sheep and the bovines.

With the 2006 and 2007 campaigns, more data have been collected from the earliest levels (748 identified remains, compared to only 112 in 2006). These layers, dated to the end of the EPPNB, are

characterised by pisé architecture (reed bundles and clay) and the use of mudbricks occurring later in the level B8. Most of the flint tools are made on blades extracted from bipolar naviform cores, a technology developed in the northern Levant, whereas the typology shows close relationships with the southern corpus (F. Abbès, personal communication). This paper addresses two issues: 1) *Ovis*, *Capra*, *Sus* and *Bos* were they domesticated since the first occupations? 2) How did the animal domestication at Tell Aswad take part in the dynamic patterns particular to the northern and the southern areas?

Methods

The morphological criteria commonly used to distinguish the domestic specimens of *Ovis*, *Capra*, *Bos* or *Sus* from the wild ones (see Peters *et al.* 2005; Vigne *et al.* 2005; Helmer & Gourichon 2008) cannot be easily applied for the earliest levels of Tell Aswad because of the low number of identified remains and the absence of diagnostic anatomical parts. Only a morphometric study can explore this issue.

Contrary to what is often accepted, the biological size is not the best indicator of domestic status for the ungulates. Indeed, if size relies on both genetic and ecological factors, the observed variations in size can result from a general isometric variation, without any modification in shape, but can be due also to modifications in proportions (Mosimann 1970; Vigne *et al.* 2005). In the first case the main factor can be the environmental pressure while in the latter genetic changes or human actions can be involved. For instance, phalanges of cattle can be distorted by ploughing (distortions often considered as pathologies although they do not really alter the life span of the animal). Thus, variations in shape during a short time (i.e. some years for modifications due to work and a number of generations with genetic drift) in non-insular populations are more likely a direct consequence of human action.

In order to make a comparative study between the potential domestic species at Tell Aswad and their wild counterparts, we take into account the most abundant bones. A combination of methods is applied to the available biometric data.

First, the variations in bone size and shape are examined through a principal component analysis (PCA) of the raw values for every measure of a given bone (e.g. GLi, Bd and Dl of the astragalus, cf. von Driesch 1976). The first component of the PCA provides, to a large extent, information about the changes or differences in the isometric size, while variations in shape are rather expressed by the second component (Lleonart *et al.* 2000). Because bone allometries are

growth differences observed on some parts of the bones, they can be generally identified in two ways: 1) all the measures decrease but at different speed, then some parameters are not necessarily correlated with the isometric size; 2) one measure decreases whereas another increases or remains stable, then the correlation between the two measures is negative.

Because the corpuses dated to the EPPNB are generally small, the method of Log size index (LSI) is also used here to check the potential variations in size (Meadow 1999). Our standard dataset is not based on a single modern animal, contrary to the usual procedure, but on the means of several biometric data collected from different PPNA, EPPNB and MPPNB sites: eight sites for the *Bos* genus (Mureybet, Jerf el Ahmar, Dja'de el Mughara, Tell Aswad, Halula 1/9, Göbekli, Nevalı Çori and Cafer Höyük), four for *Capra* (Cafer Höyük, Tell Aswad, Halula 1/9 and Maghzaliyah), 13 for *Ovis* (Mureybet, Jerf el Ahmar, Göbekli, Halula 1/9, Nemrik, Sotto, Kultepe, Maghzaliyah, Ras Shamra VC and VA, Qdeir, El Kowm 2, Cafer and Bouqras) and four for *Sus* (Mureybet, Jerf el Ahmar, Göbekli and Tell Aswad) (Helmer in press). This 'internal' analysis of the biometric variations allows a more accurate identification of the allometries (see [Appendix](#) for the selected measurements). This global standard made from various Neolithic specimens from Turkey, Syria and Iraq is called 'NE referential' (NE for Near East).

Lastly, our morphometric study is improved by applying the method developed by J. E. Mosimann (1970; see also Leonart *et al.* 2000). This method aims, on the one hand, to remove for every measurement all the information related to size and, on the other, to isolate the isometric size by reducing the shape effect. This is obtained by calculating indices using logarithmic functions, i.e. respectively: a shape index for each measure (LSR, Log Shape Ratio) and an index for the global isometric size.

The limitations of the dataset used for comparison rely fundamentally on four points: 1) the number of available biometric data for the EPPNB levels of Tell Aswad; 2) the number of sites in the northern and southern Levant which have yielded a sufficient amount of specimens per taxa; 3) the number of sites where the required measurements were taken and published; 4) the choice of sites where only wild ancestors are present for composing the wild standard. In order to avoid as much as possible the influence of potential major climatic changes for the comparison with the wild populations, we choose to use data from the Early Holocene (PPNA, second half of the

10th millennium and early 9th millennium cal BC) when it is assumed that the ungulates were not already domesticated. If the corpus is suitable for *Bos*, *Ovis* and *Sus* (from Mureybet, Jerf el Ahmar, Göbekli, Körtik), this is not the case for *Capra* because of the lack of available data for this period. By default, we will use the corpus from Cafer Höyük (Early and Middle PPNB) where both wild and domestic goats have been identified (Helmer 2008).

Material

The total number of identified specimens at Tell Aswad is 9682 remains, compared to 7964 in 2006 (Table 3.1). As a whole, there is no real change except a slight evolution in the earliest levels (632 remains of large mammals, three of rodents, three of hedgehogs, 113 of birds and some small fish bones). With these recent data, no new taxa was added to the previous list which comprises (Helmer & Gourichon 2008), in addition to four domestic ungulates (*Bos*, *Ovis*, *Sus* and *Capra*), red fox (*Vulpes vulpes*), wolf (*Canis lupus*) and dog (*Canis familiaris*), badger (*Meles meles*), jungle cat (*Felis chaus*), cat (*Felis silvestris/catus*), sand cat (*Felis margarita*), three equids (*Equus* cf. *asinus*, *E. cf. hemionus*, *E. cf. hemippus*), two gazelles (*Gazella subgutturosa* cf. *marica* and *G. gazella*), Mesopotamian fallow deer (*Dama mesopotamica*), and hare (*Lepus capensis* format *syriacus*).

The correspondence analysis of the NISP per taxa (Fig. 3.1), after weighting the raw data on a pro-rata basis (see Helmer & Gourichon 2008), shows a clear time effect along the axis 1 (contribution of 59.2%): the values are more or less regularly distributed from the earliest level (B12) to the most recent (B-5), with the exception of the assemblages found in the Pottery Neolithic pits (level A). The first component also indicates a partition between wild (birds, hares, small carnivores, gazelles) and domestic taxa (*Capra*, *Ovis*, *Sus*). We can interpret this trend as follows: a) in the first levels (B12 to B9), hunting takes an important part, especially the hunting of small game (birds, hares and carnivores); b) in the early Middle phase (levels B8 to B5), the hunting of gazelles is significant but the part of small game is reduced; c) in the late Middle phase (B4 to B1), the goat husbandry is predominant; d) in the most recent PPN occupations of Tell Aswad (B0 to B-5), the rule played by the domestic caprines is much more substantial; and e) in the Pottery phase (level A), cattle seems to have been predominant. However, if the overall distribution is progressive, the most obvious disruption appears between levels B5 and B4, with a shift from *Gazella* to *Capra*, although no change has been stratigraphically noticed through the Middle phase of Tell Aswad

during the excavations.

Bovines (*Bos primigenius/taurus*)

The referential used for the aurochs (*Bos primigenius*) comes from the following PPNA sites: Mureybet III, Jerf el Ahmar and Göbekli III. The PCA includes also cattle remains from Early and Middle Aswad, Halula 1/9 and 10/19, Bouqras 11/5, Dja'de el Mughara, Mureybet IVA and IVB, Göbekli II, Gürcütepe and Nemrik V. There is only one measurable astragalus in the earliest occupations of Tell Aswad and 12 from the Middle phase. The measurements taken into account in the analysis are GLL, Bd and Dl.

Table 3.1. Faunal remains found at Tell Aswad. Distribution of the NISP throughout the levels of occupation: ‘Pottery’ phase (level A), ‘Late’ phase (B-5 to B0), ‘Middle’ phase (B1 to B8), ‘Early’ phase (levels B9 to B12).

Taxa	A	B-5	B-2	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	B9/10	B10	B11	B12
Carnivora indet.	1	1	2	4	1	1	1	5	1	1		2					
Vulpes sp.	3		3	2	1	2	1	12	2	1		5	2	2			3
Canis sp.			1			1						1					
Meles sp.								1	2				1				
Felis silvestris	1		1			2		5	1			2			1		
Felis chaus							1	3	1	1	1				2		1
Equus sp.	18		5	2	6	3	5	13	2	1		1	1	1	2		1
Sus sp.	50	36	76	5	19	30	45	198	23	10	25	22	9	7	12	1	10
Bos sp.	98	38	46	12	9	25	30	59	30	26	29	49	10		8		3
Total small ruminants	475	458	710	155	255	304	332	781	273	188	291	347	114	103	172		110
Total Ovis/Capra	210	319	444	64	141	204	189	428	119	79	148	81	46	54	72	2	35
Ovis sp.	15	9	33	3	5	4	2	34	6	2	7	2	2	2	2		2
Capra sp.	81	108	203	21	68	93	81	149	44	41	79	31	18	23	29		15
Gazella sp.	162	55	114	31	61	59	84	225	119	77	106	221	53	28	77	3	69
Dama sp.	1							3		2							
Lepus sp.	6	6	7	10	5	12	29	141	16	3	6	21	3	1	14	1	8
NISP	652	539	851	190	296	380	444	1218	351	231	352	450	140	138	211	7	136
Hedgehogs				1		1	2		1				2		1		
Rodents				1	1			1	4			3			1		2
Birds	12	9	16	4	11	27	56	64	76	6	31	83	8	24	46	6	29
Tortoise					1		1	2	1								
NISP total	664	548	867	196	309	408	503	1285	433	237	383	536	150	162	259	13	167

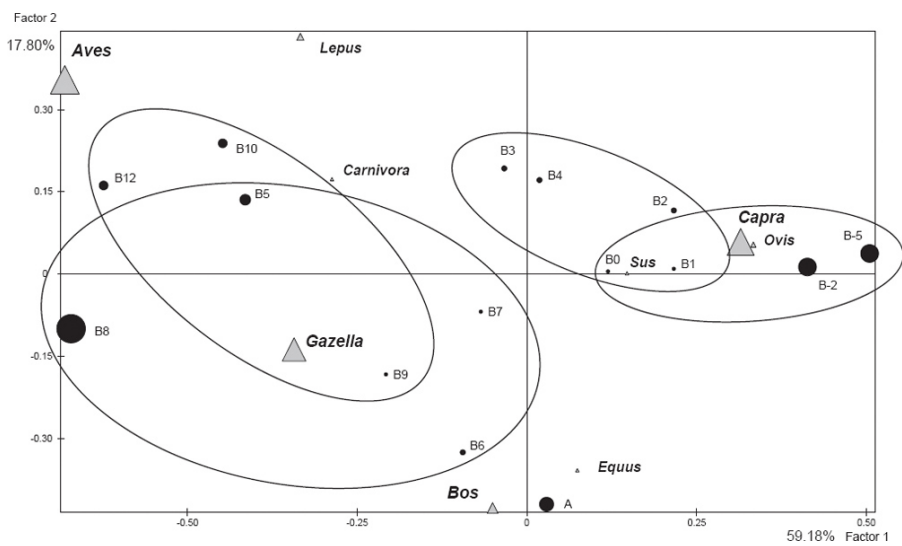


Fig. 3.1. Distribution of the frequencies of the main taxa identified at Tell Aswad (*Equus*, *Bos*, *Gazella*, *Ovis*, *Capra*, *Sus*, *Carnivores*, *Lepus*, *Birds*) according to the first and second axes of the component analysis (SPAD software).

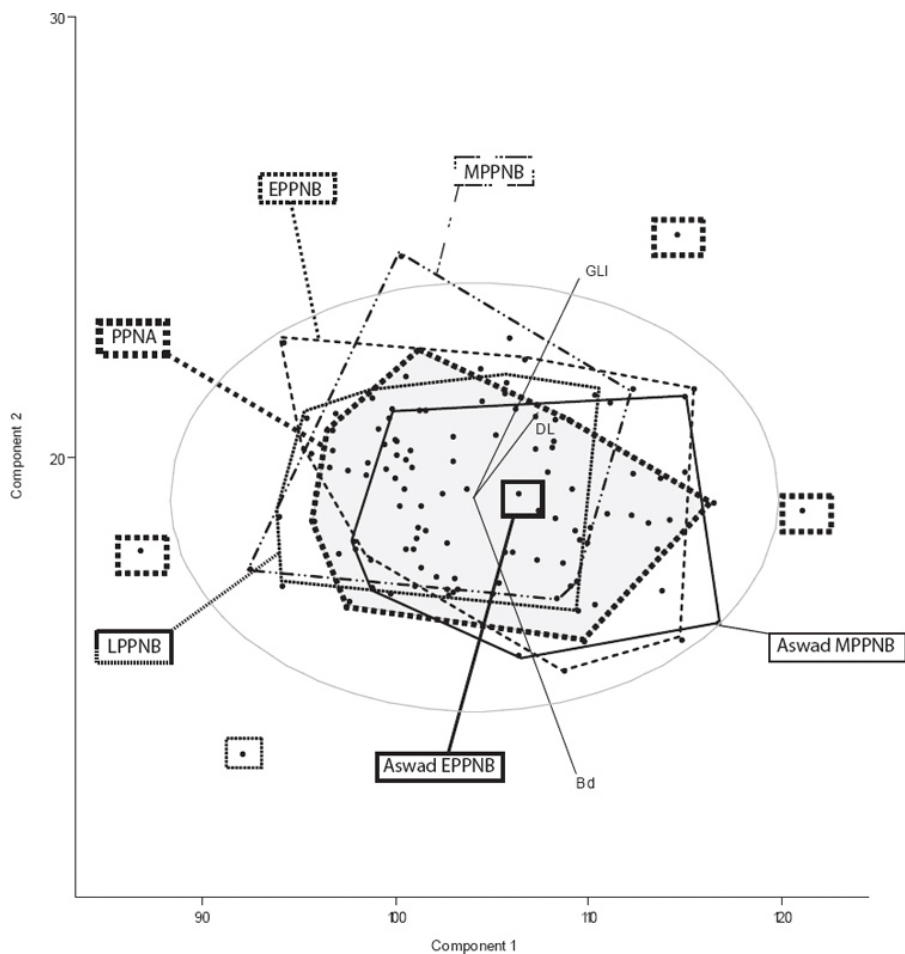


Fig. 3.2. Size comparison of the astragali of *Bos* from Tell Aswad with the PPNA aurochs (in grey) and bovines from other Early, Middle and Late PPNB sites. Principal component analysis (Past software).

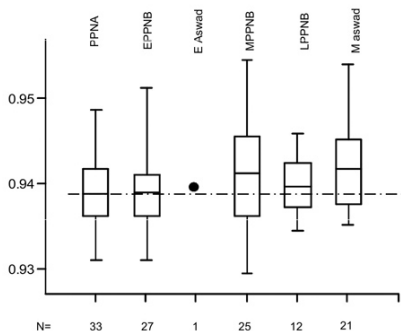
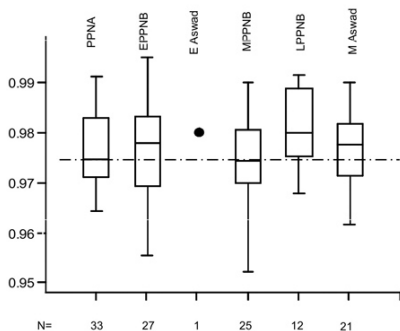
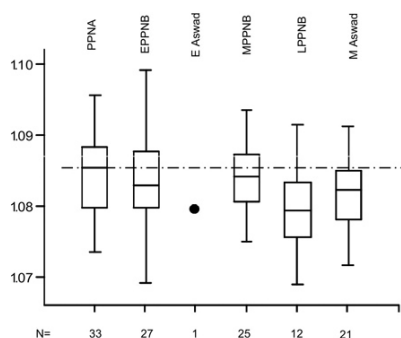
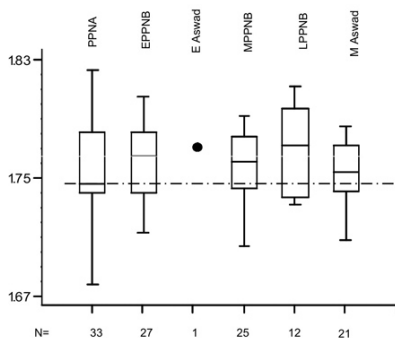


Fig. 3.3. Shape comparison of the astragali of *Bos* from Tell Aswad with the PPNA aurochs and bovines from other Early, Middle and Late PPNB sites (Mosimann's method). Box plots showing the indices of isometric size and the shape indices (Log Shape Ratios) for GLI, Bp and Bd (Past software). The dashed line indicates the median for the PPNA aurochs. E Aswad = Early phase; M Aswad = Middle phase.

It is self-evident that little information can be deduced from the single bone from Early Aswad, apart from the fact that it fits well within the variation range of the aurochs astragali and the other specimens from later levels of Tell Aswad (Fig. 3.2). Indeed, the bone size considered as a whole is not a pertinent criterion for distinguishing wild and domestic cattle (Helmer *et al.* 2005), as illustrated in Figure 3.2 where a slight shift of the distribution appears only in the MPPNB.

The indices of isometric size obtained from the Mosimann's analysis are higher within the domestic groups (Early, Middle and Late PPNB) than for the aurochs (Fig. 3.3). The correlation indices show that the first component is correlated with the isometric size (ISi/axis 1: $r = 0.996$; Puncorr = 0.0000), whereas the second component is

independent (ISi/axis 2: $r = -0.017$; Puncorr = 0.855). This latter therefore indicates the presence of allometries.

The shape indices (LSR) for Bd and DI (Fig. 3.3) are also higher than the aurochs median but, on the contrary, the length (GLI) is much smaller: the domestic astragali are stockier than those of aurochs. Since the corpus from Tell Aswad (including the single astragalus found in the earliest phase) shows the same variations both in the raw biometric data than in the shape indices, this assemblage can be interpreted as mostly or entirely 'domestic'. Evidence of allometries for *Bos* confirms here our previous diagnosis made by using other methods (Helmer & Gourichon 2008).

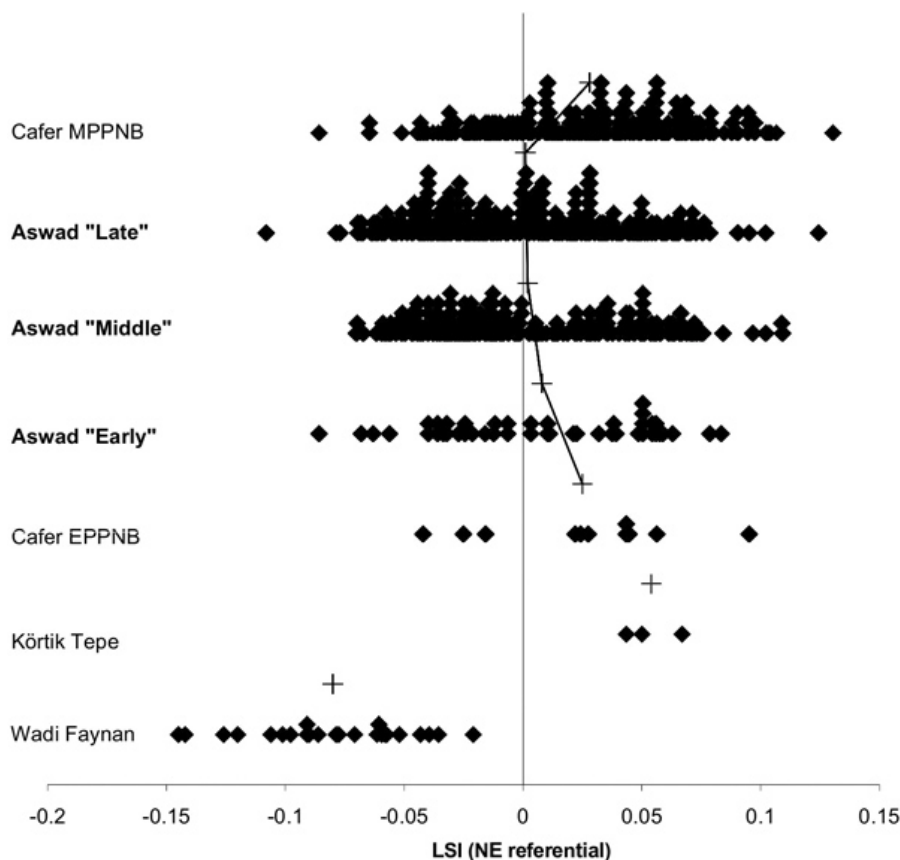


Fig. 3.4. Comparison of the biometric data (LSI) of *Capra* from Tell Aswad with *C. nubiana* from Wadi Faynan (Jordan) and the goats (*C. aegagrus/hircus*) from SW Turkey: Körtik (PPNA) and Cafer Höyük (Early and Middle PPNB).

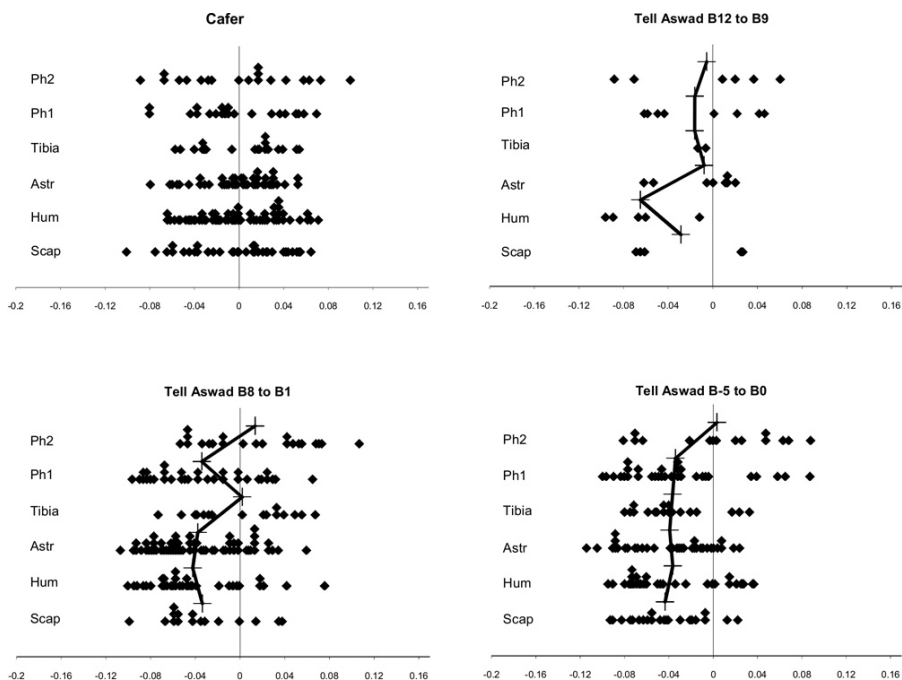


Fig. 3.5. Distribution of LSI of the most abundant measures of Capra from Tell Aswad using the data from Cafer Höyük as standard.

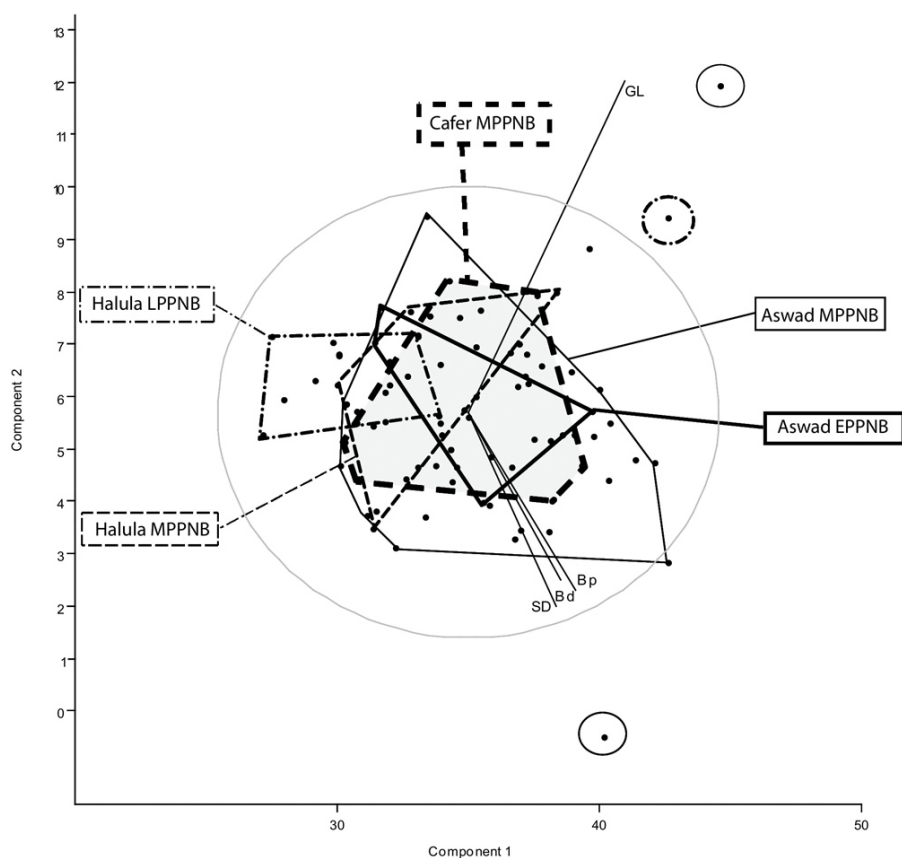


Fig. 3.6. Size comparison of the second phalanges of *Capra* from Tell Aswad with the goats from Cafer Höyük (in grey) and Tell Halula. Principal component analysis (Past software).

Goats (*Capra aegagrus/hircus*)

In a previous study (Helmer & Gourichon 2008), it was asserted, according to the morphology of the horncores, that the populations of goats at Tell Aswad were heterogeneous and that a wild population different from the Nubian ibex (*Capra nubiana*) was present. This assertion is verified by the distribution of the biometric data using the LSI method (Fig. 3.4). The sample from Wadi Faynan corresponds to remains of Nubian ibex found in the PPNB levels (Carruthers 2002). The LSI distribution of Tell Aswad indicates that, whatever the phase, the goats are larger than *Capra nubiana*. Since no sufficient data from 'purely' wild goats living in the past times are available, the comparison can be only made with Cafer Höyük where populations of bezoars (*Capra aegagrus*) and domestic goats are mixed, probably at parity (Helmer 2008). As a result, the mean values of Tell Aswad are slightly smaller than those of Cafer Höyük (Early and Middle phases).

Moreover, there seems to be a progressive reduction of the mean value across the time, which can be expected during few centuries if the goats were domestic since the first occupations. Such a hypothesis is tested here by examining separately the biometric data of six different skeletal parts (scapula, humerus, astragalus, tibia, first and second phalanges).

First, when comparing the two sites using the data from Cafer as LSI standard for each kind of bone (scapula, humerus, astragalus, tibia, first and second phalanges), we observe that there is a general reduction in the mean values from the bottom to the top of Tell Aswad (Fig. 3.5), except for the second phalanges. We will consider now the two bones representing the extremes of this allometry: the second phalanges which do not vary (or vary a little) and the astragali which change along the sequence.

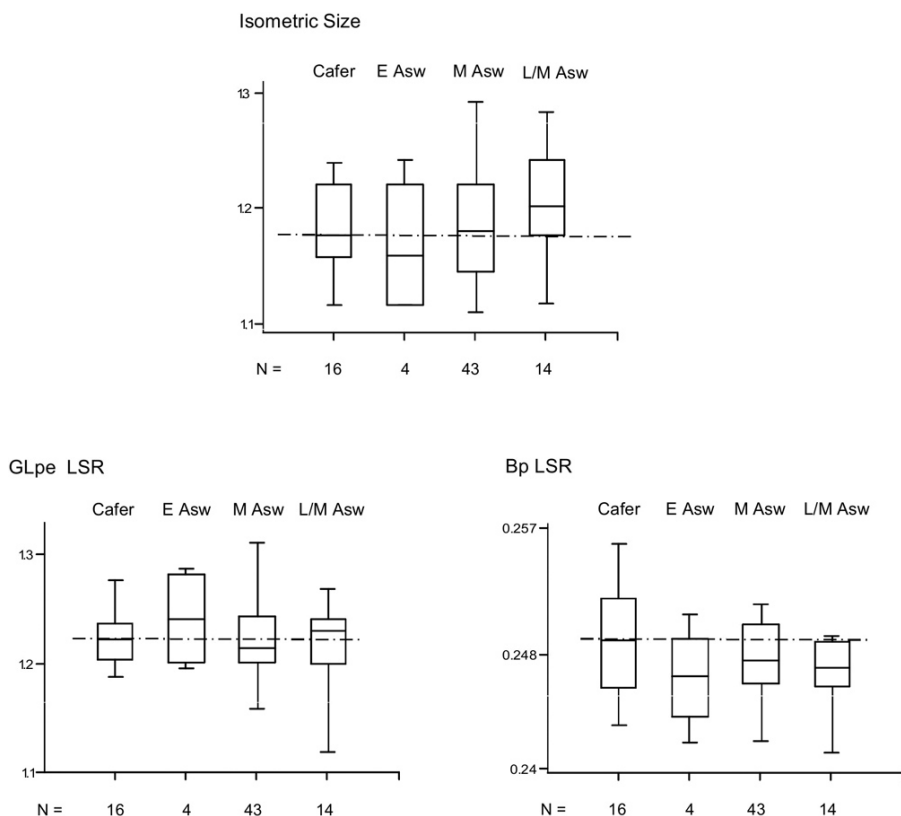


Fig. 3.7. Shape comparison of the second phalanges of *Capra* from Tell Aswad with the goats from Cafer Höyük (Mosimann's method). Box plots showing the indices of isometric size and the shape indices (Log Shape Ratios) for GLpe and Bp (Past software). The dashed line indicates the median for the Cafer goats. E Asw = Early phase; M Asw = Middle phase; L/M Asw = transition Middle/Late PPNB.

The size analysis (PCA) of the second phalanges from the sites of Tell Aswad, Cafer Höyük, Tell Qarassa and Tell Halula, using GLpe, Bp, SD and Bd, indicates that the four specimens from Early Aswad do not differ from Cafer (N=16) (Fig. 3.6). For the Middle phase, the distribution is moved towards the right part of the graph, while the specimens from the later phase are much more scattered. This trend suggests that the evolution process at Tell Aswad could have started with phalanges similar in size to those of the Northern goat populations.

The isometric size of the second phalanges shows a progressive change compared to Cafer (Fig. 3.7): Early Aswad phalanges seems slightly smaller and the size starts to increase at the end of the Middle PPNB. The first component of the correspondence analysis is correlated with the isometric size (ISi/axis 1: $r = 0.968$; Puncorr = 0.0000), whereas the second is independent (ISi/axis 2: $r = -0.238$; Puncorr = 0.027, i.e. between the limit values of 0.05 and 0.01). These results evidence allometries, such as for the astragali of bovines. The shape indices show that the length (GLpe) is not a good criterion, contrary to the proximal breadth (Bp) which is much smaller at Tell Aswad, in the oldest as well as in the recent levels.

Concerning the astragalus (Fig. 3.8), the size analysis shows that although the range of variation of the Early Aswad specimens fits approximately that of Cafer Höyük, they are in average smaller. Middle Aswad and other MPPN sites follow a similar pattern with a distribution expanded to the bottom and the left, a discrepancy much more obvious for the LPPNB sites. This evolution is approximately the same as that we observed for the second phalanges.

The isometric size of the population from Early Aswad is larger than that of Cafer, but the values of the other phases remain smaller (Fig. 3.9). There is a correlation between this size and the first component (ISi/axis 1: $r = 0.997$; Puncorr = 0.0000), but not with the second component (ISi/axis 2: $r = 0.03$; Puncorr = 0.629). We can notice that the shape indices for Bd and GLl are negatively correlated ($r = -0.67$): all the astragali of Tell Aswad have high GLbased indices while the Bd-based indices are relatively smaller. When this observation is related to the decrease of the global isometric size, it appears that the astragali of the goats became proportionally longer but thinner over time, and then more slender than the mixed populations of Cafer.

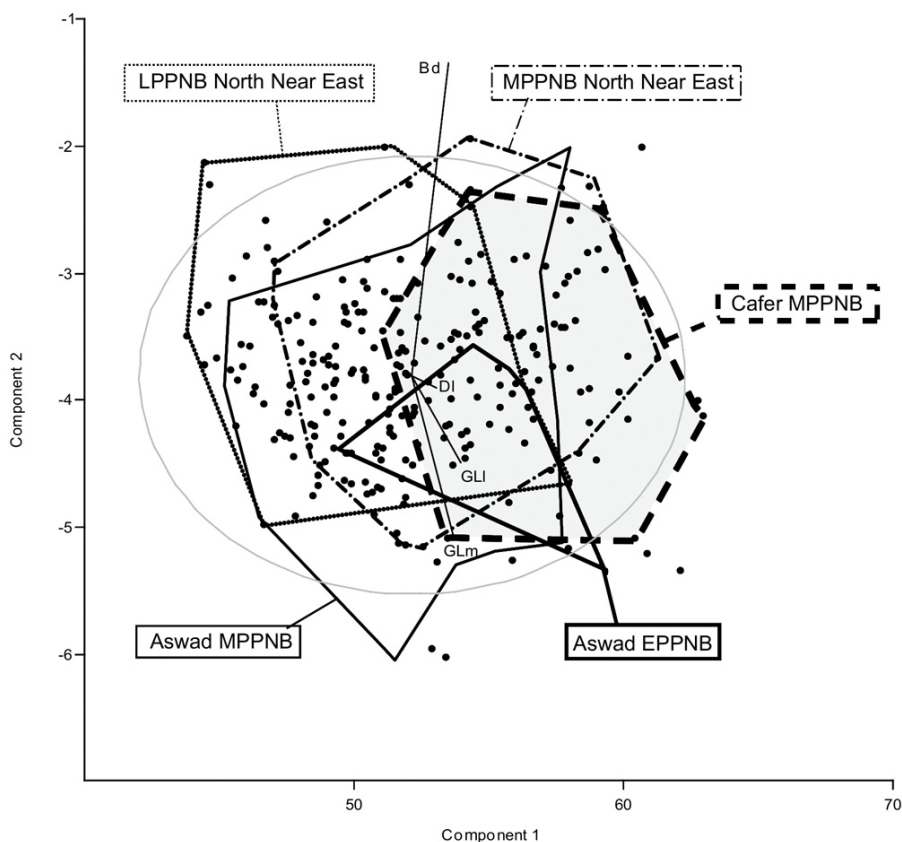


Fig. 3.8. Size comparison of the astragali of *Capra* from Tell Aswad with the goats from Cafer Höyük (in grey) and other MPPNB and LPPNB sites. Principal component analysis (Past software).

Therefore, the biometric analysis of the second phalanges and the astragali strongly suggests that the goats of Tell Aswad are domestic, possibly since the first occupations.

Sheep (*Ovis orientalis/aries*)

The number of biometric data available for the Early phase of Aswad is very low ($N=8$). However, the mean and the range of variation of the LSI values for this period is quite similar to those for the upper levels ($N=24$ for the Middle phase, and $N=161$ for the Late phase). There is apparently no evolution along the sequence (Fig. 3.10). The sheep of Tell Aswad are relatively large in size but the distribution of the values is asymmetric, with an obvious slant towards the smaller specimens. Their means are smaller than that of the mouflons from the Euphrates Valley, which also present the same asymmetry in the distribution. In the latter case, this is due to the sexual dimorphism,

with hunting being focused mainly to the females (Gourichon & Helmer 2008).

For the Early PPNB, the mean values seem to be consistent between Cafer, Dja'de or Nevalı Çori (Fig. 3.11) and are smaller than the PPNA wild sheep. On the basis of this observation, and given the fact that no major climatic change occurred between the PPNA and the Early PPNB, A. von den Driesch and J. Peters asserted that sheep was domesticated at that time (Driesch & Peters 2001). Can the reduction in size of the sheep be also related to its domestic status at Tell Aswad?

According to the PCA made for the first phalanges (GLpe, Bp, SD and Bd), the 3 phalanges from Early Aswad are outside the range of variation of the mouflons but are very close to that of the specimens found in the Middle phase (Fig. 3.12). The isometric size is correlated with the two main components, but in a negative way (ISi/axis 1: $r = 0.878$, Puncorr = $9.9E-34$; ISi/axis 2: $r = -0.472$, Puncorr = $5.3E-07$).

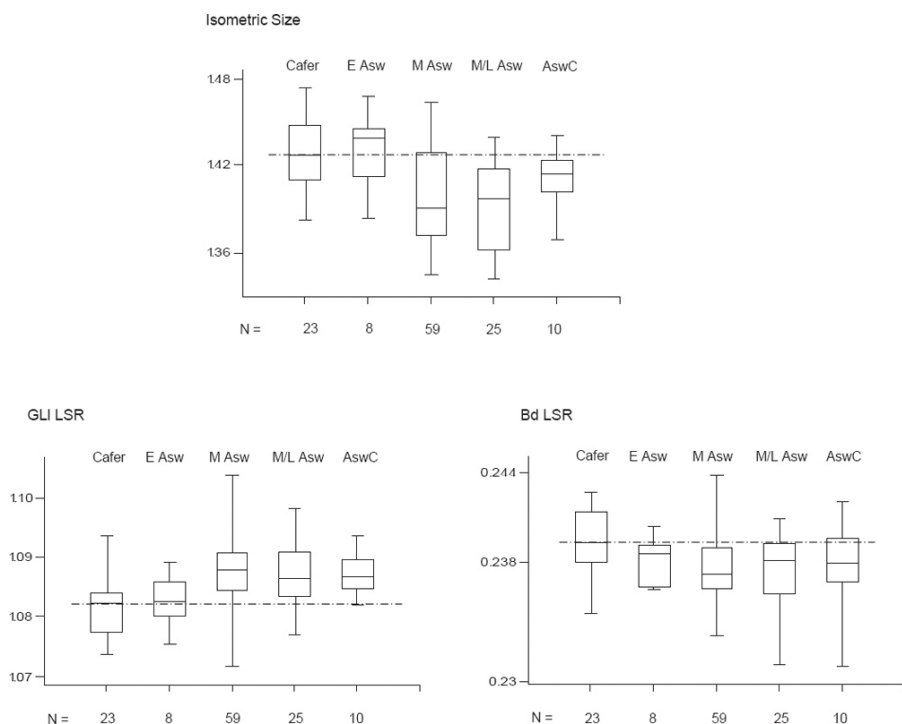


Fig. 3.9. Shape comparison of the astragali of *Capra* from Tell Aswad with the goats from Cafer Höyük and other MPPNB and LPPNB sites (Mosimann's method). Box plots showing the indices of isometric size and the shape indices (Log Shape Ratios) for GLI, Bp and Bd (Past software).

The dashed line indicates the median for the Cafer goats. E Asw = Early phase; M Asw = Middle phase; L/M Asw = transition Middle/Late PPNB; AswC = Middle PPNB layers from the Area C of Aswad.

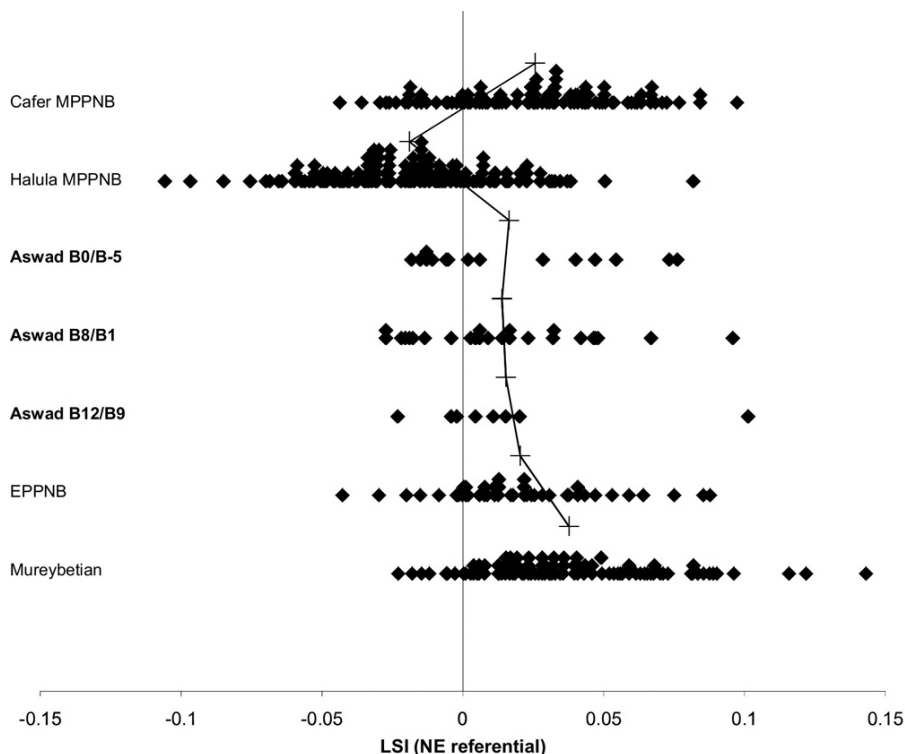


Fig. 3.10. Comparison of the biometric data (LSI) of Ovis from Tell Aswad with the PPNA (Mureybetian) mouflons and the sheep from Cafer Höyük (Early and Middle PPNB) and Halula (Middle and Late PPNB).

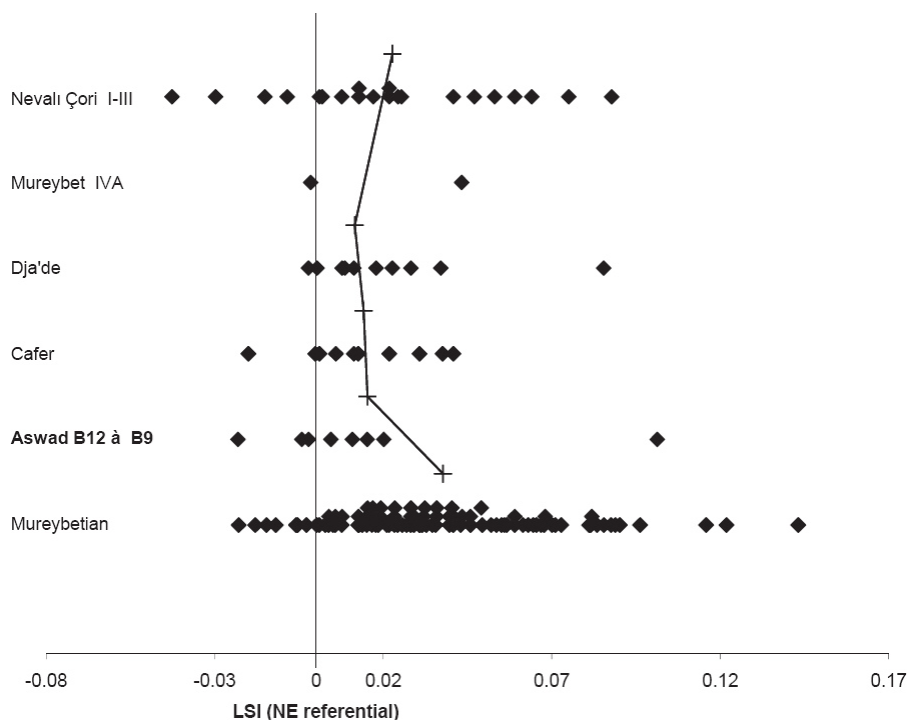


Fig. 3.11. Comparison of the biometric data (LSI) of Ovis from Tell Aswad with sheep from Early PPNB sites.

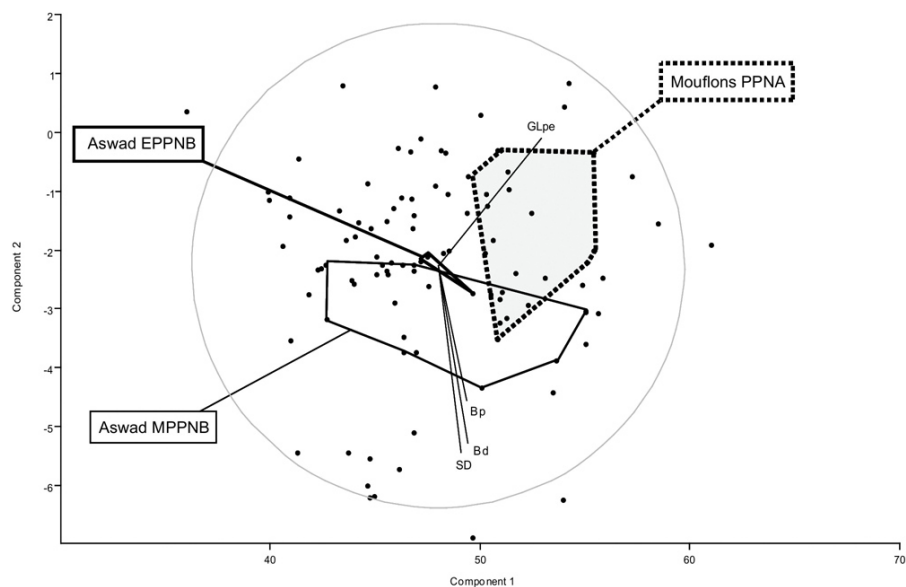


Fig. 3.12. Size comparison of the first phalanges of Ovis from Tell Aswad with the PPNA mouflons (in grey). Principal component analysis (Past software).

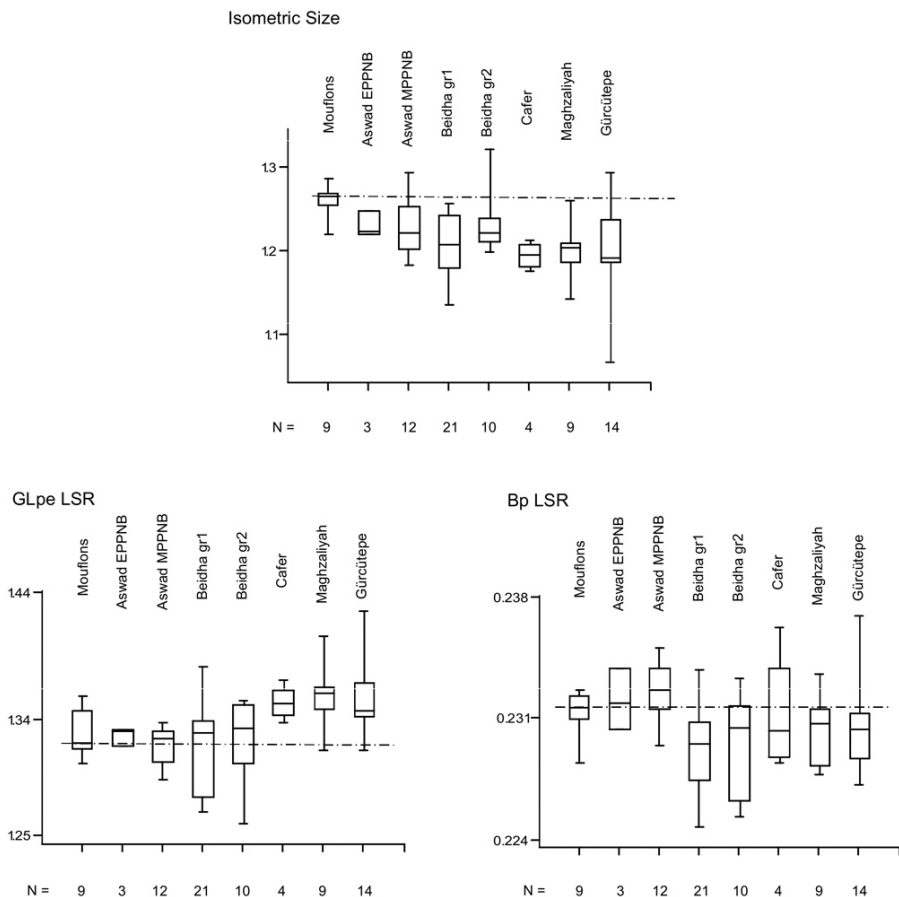


Fig. 3.13. Shape comparison of the first phalanges of Ovis from Tell Aswad and other PPN sites with the PPNA mouflons (Mosimann's method). Box plots showing the indices of isometric size and the shape indices (Log Shape Ratios) for GLpe and Bp (Past software). The dashed line indicates the median for the PPNA wild sheep.

Regarding the shape analysis, we can see that, despite a clear reduction in the isometric size compared to the PPNA mouflons, the Bp indices increase and the GLpe indices do not change at the same time for the Aswad populations (Fig. 3.13): the phalanges from Tell Aswad are stockier than the phalanges of wild sheep. On the other hand, at Cafer and Maghzaliyah (domestic), Bp is smaller and GLpe larger: the breeds have more slender phalanges. At Beidha, whatever the group considered, Bp is smaller and GLpe slightly larger than those of the mouflons, like in the Northern Levant. Consequently, the general decrease in size and the presence of important allometries

argue for the domestication of sheep in the Early PPNB at Tell Aswad. The study of the humerus, still in progress, seems to go along the same lines.

Pigs (*Sus scrofa/domesticus*)

For the pig bones, the number of variables for applying the LSI method is low (N=8), due to the usual predominance of young or subadult animals (scarcity of completely fused long bones) in Neolithic sites. Therefore, the results obtained from the size analysis have to be considered with caution. As a whole (Fig. 3.14), the mean values of Tell Aswad appear smaller than the data from the PPNA period (Mureybet II/III, Jerf el Ahmar, Göbekli III). Consequently, these pigs could be domestic.

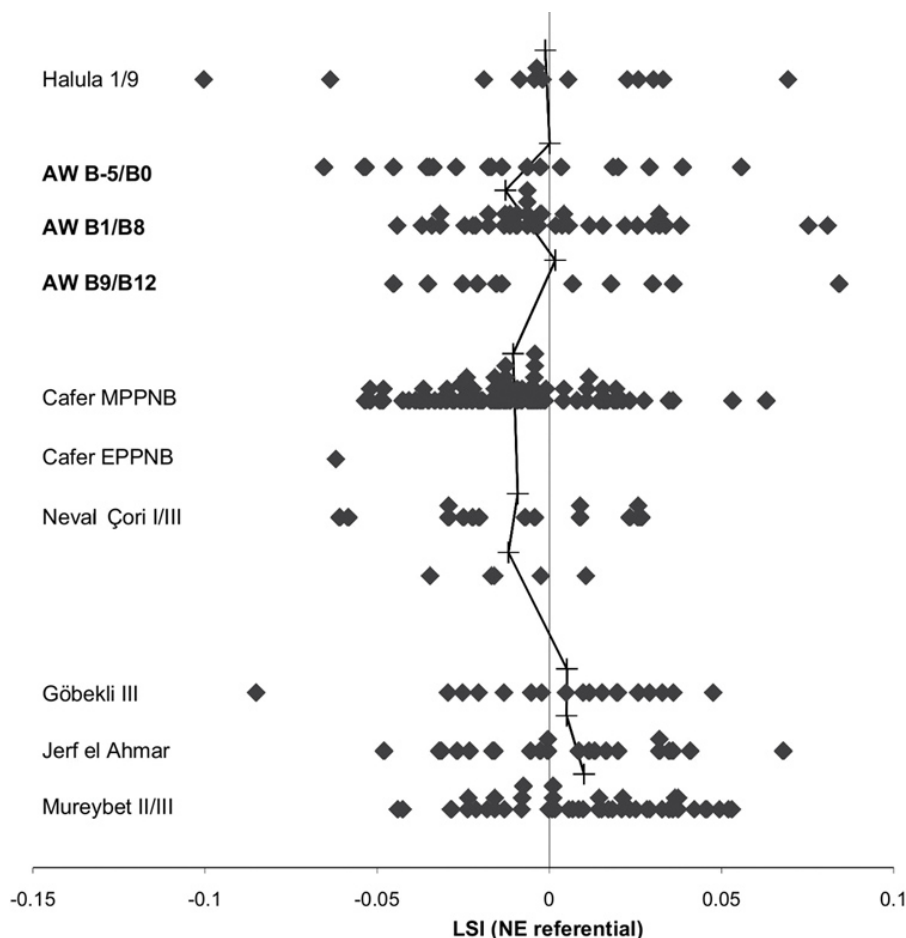


Fig. 3.14. Comparison of the biometric data (LSI) of *Sus* from Tell Aswad with the PPNA wild boars (Mureybet, Jerf el Ahmar and Göbekli III) and

pigs from the Early (Dja'de, Nevalı Çori I/III, Cafer) and Middle PPNB (Cafer, Halula 1/9).

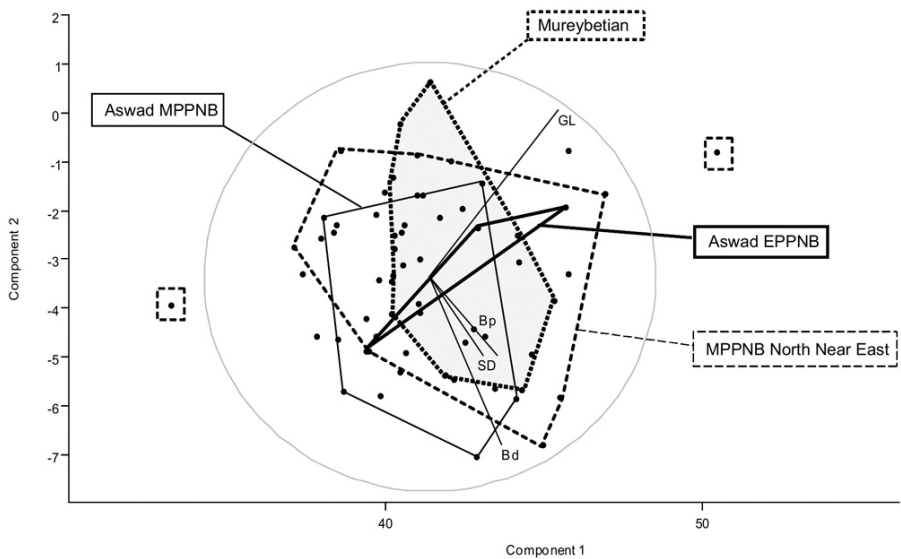


Fig. 3.15. Size comparison of the second phalanges of *Sus* from Tell Aswad with the PPNA wild boars (in grey) and pigs from other Middle and Late PPNB sites. Principal component analysis (Past software).

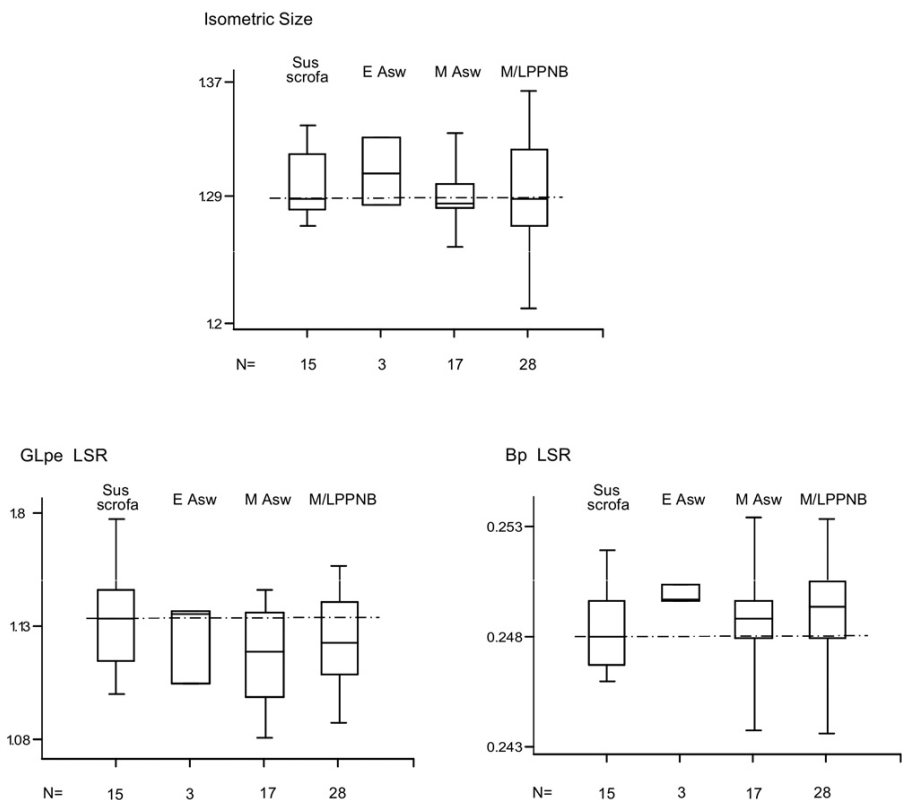


Fig. 3.16. Shape comparison of the second phalanges of *Sus* from Tell Aswad with the PPNA wild boars and pigs from other Middle and Late PPNB sites (Mosimann's method). Box plots showing the indices of isometric size and the shape indices (Log Shape Ratios) for GLpe and Bp (Past software). The dashed line indicates the median for the PPNA wild boars.

Only one set of data is useful for the analysis of the variations in size and shape: the second phalanges. Regarding the size, the results of the PCA (ISi/axis 1: $r = 0.29$, Puncorr = 0.0223, significant; ISi/axis 2: $r = -0.054$, Puncorr = 0.673, non significant) show that the specimens from Early Aswad ($N=3$) match well with the wild population (PPNA) and those from the Middle phase ($N=17$) are located in the bottom-left part of the graph (Fig. 3.15). For the other samples from MPPNB and LPPNB sites, the range of variation is so large than it incorporates all the assemblages.

The indices of isometric size do not present any clear variation over time (Fig. 3.16). However, looking at the shape indices, it appears that the Bp values are much higher and the GLpe values smaller than the wild standard (correlation Bp LSR/GL LSR, $r = -0.23$, Puncorr = 0.069, non significant but just under the 0.05 threshold): the

phalanges of domestic pigs are in general stockier. The same trend is observed for every phase at Tell Aswad. Then, domestic pigs are probably present at the site since the earliest occupations.

Conclusions

The combination of different methods for analysing both the size and the shape (proportions) of the bones can be useful when dealing with small assemblages. The LSI method has been used here to detect the presence of variations in the general size. If this all-embracing method is not always meaningful (especially when samples are too small), it can be applied in addition to other statistical tools and can give relevant results when the variation in size over time is the main studied parameter. Bearing in mind that this variation remains one of the criteria which can be used for identifying the domestication: reliable for sheep and pig, fairly secure for goat but weaker for cattle (Helmer *et al.* 2005; Helmer & Gourichon 2008). For instance, the fact that the mean values of the goats from Tell Aswad are lower than those of the EPPNB and MPPNB populations from Cafer Höyük reinforces the hypothesis about their domestication in the earliest levels of the site. The same argument can be proposed for the pigs.

The application of a principal component analysis to the raw biometric data allows us to assess the variability in size and shape of a given skeletal part. On the one hand, the global size variation (isometric size) is mainly expressed by the first principal component (axis 1). Indeed, differences between males and females and of between domestic and wild can be observed on this axis. On the other, the second component (axis 2) displays especially the variations in proportions, namely the allometries, which can be negatively correlated with or independent from the isometric size. Then, the calculation of size and shape indices, following the Mosimann's method, gives the possibility to study more precisely – and separately – the variation of each parameter (i.e. bone measures).

The analysis of the potential domestic ungulates found in the deepest levels of Tell Aswad (Early PPNB) provides various results. First, determining the status of the sheep at Tell Aswad is rather easy: the bones which were taken into account for the study are obviously different in size as well as in shape from the wild standards (PPNA populations of the Northern Near East). These sheep can be then considered as domestic. Secondly, for the goats, the absence of data which could be representative of the local wild populations and the occurrence of distinct allometries complicate the study. However,

based on the most relevant dataset (from the astragalus), a general smaller size and a probable genetic drift suggest that the goats are domestic. Thirdly, the second phalanges of pigs from Early Aswad do not seem to vary in size but are similar in shape to the domestic pigs, like those from the Middle PPNB which are clearly distinct from the wild boar. This observation suggests that pigs are domestic in the oldest levels, but the low number of specimens and the particular nature of the bone (phalange) do not allow us to conclude with certainty. Lastly, it remains difficult to assert whether the bovines from Early Aswad are domestic or not, although their domestic status is clearly defined as least from the earliest level (B8) of the Middle phase (Helmer & Gourichon 2008). Since the first evidence for the domestication of cattle were found in the Early PPNB of Dja'de el Mughara (Helmer *et al.* 2005), it implies that either the presence of domestic bovines (and pigs) is later at Tell Aswad, or that these animals arrived altogether with the other domestic taxa.

As a major result, it seems evident that at least one species, sheep, is domestic at Tell Aswad in the earliest occupations. This animal is present in the oldest layer excavated at the site. So, if this level corresponds to the first occupation, this implies that the village was settled at the end of the Early PPNB period by a community of herders. The site location, on the bank of a permanent lake, nearby hilly landscape where flint sources are abundant, was very well suited for agriculture (rich soils) and herding (grasslands and reed beds). Moreover, the Damascus Oasis, at the foot of wooded mountains and on the edges of dry steppe areas, is at crossroads between Northern and Southern Levant and between the inland and the coastline. With herding based on caprines and hunting focused on small game, Tell Aswad is economically more related to the Southern than to the Northern Levant (Helmer & Gourichon 2008). The lithic industry comprises also typologically 'southern' tools but made with technologically 'northern' supports, i.e. with blades produced from bipolar naviform cores (F. Abbès, personal communication).

The hypothesis we can make about the first settlement of Tell Aswad is as follows: if there was acculturation from the North (introduction of some techniques), as is likely the case, the integration of these techniques was made in accordance with cultural modalities particular to the Southern Levant. In other words, if the human group was originated from the South or the nearby territories and accultured by contact with the North, they certainly acquired new techniques (husbandry, flint knapping) but managed them in their own way. Most of the questions about the beginnings of the animal domestication and

the diffusion/adoption of new technological knowledge rely on the archaeological data available for this critical period (9th millennium BC). In this sense, the large region extended from the Euphrates Valley to the Damascus Oasis remains little known until now. Recent excavations and material studies carried out in Lebanon and Southern and Western Syria will hopefully provide new information about the local wild populations of ungulates and, consequently, about the emergence of husbandry in this area.

Note

- 1 The annual rainfall is 150–200mm today.

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Appendix. Measurements and mean values used for the calculation of the Log Size Index (LSI), Near Eastern (NE) referential.

Bos sp.

Humerus	Bd	Bt	Htr
M	101.95	90.98	56.9
N	14	24	26

Scapula	GLP	LG	BG
M	82.26	65.58	55.16
N	21	22	25

Radius	Bp	Bfp	Dp	Bd
M	98.68	88.04	50.57	89.22
N	15	11	15	15

Carpi II-III	GB
M	42.62
N	72

Metacarpus	Bp	Dp	Bd	BFd
M	72.82	42.32	67.4	73.91
N	23	29	21	30

Astragalus	GLI	Bd
M	80.48	52.19
N	86	94

Metatarsus	Bp	Dp	Bd	BFd
M	58.42	58.38	66.2	71.36
N	25	10	23	25

Tibia	Bd
M	75.24
N	20

Phalanx 1	Bp	SD	Bd
M	36.27	34.94	33.55
N	204	122	96

Centrotarsale	GB
M	66.38
N	59

Phalanx 2	Bp	SD	Bd
M	35.76	29.64	30.98
N	409	317	291

Capra sp.

Scapula	GLP	LG	BG
M	36.32	29.17	24.44
N	115	128	141

Astragalus	GLI	Bd	DI
M	33.22	21.37	18
N	259	204	208

Humerus	Bd	Bt	Htr
M	36.19	33.98	21.58
N	242	226	264

Tibia	Bd	Dd
M	30.07	22.89
N	108	104

Phalanx 1	Bp	SD	Bd
M	15.02	12.39	14.33
N	193	176	176

Phalanx 2	Bp	SD	Bd
M	14.62	10.86	11.58
N	123	123	107

Ovis sp.

Humerus	Bd	Bt	Htr
M	32.96	31.49	20.49
N	222	201	229

Scapula	GLP	LG	BG
M	36.06	28	22.88
N	102	108	113

Metacarpus	Bp	Dp	Bd	BFd
M	24.44	17.76	27.30	27.95
N	46	39	30	46

Astragalus	GLl	Bd	DI
M	31.58	19.71	19.01
N	239	218	197

Metatarsus	Bp	Dp	Bd	BFd
M	22.87	23.69	26.22	26.85
N	44	19	42	53

Tibia	Bd	Dd
M	28.61	22.46
N	95	66

Phalanx 1	Bp	SD	Bd
M	13.36	10.47	12.77
N	117	108	103

Phalanx 2	Bp	SD	Bd
M	12.86	9.02	10.14
N	67	69	60

Sus sp.

Humerus	Bd	Bt
M	49.28	37.92
N	24	21

Scapula	GLP	BG
M	43.02	30.46
N	23	24

Astragalus	GLl	Bd
M	50.41	29.31
N	33	34

Radius	Bp
M	35.05
N	11

Phalanx 1	Bp
M	21.42
N	30

Metap. 3/4	Bd
M	20.44
N	23

Phalanx 2	Bp
M	19.79
N	33

Tibia	Bd
M	35.76
N	17

4. Faunal Remains from the Middle Neolithic site of Qaleh Rostam

Julie Daujat and Marjan Mashkour

The analysis of faunal remains (NISP 5801) from Qaleh Rostam, provides evidence of an early caprine based pastoral subsistence economy. It is noteworthy that sheep is absent in the earlier phase of the site. Thus, at the very beginning of 7th millennium BC, Qaleh Rostam seems to be in spatio-temporal continuity of the process of goat domestication, recognised as an independent centre in the Zagros after M. A. Zeder's and B. Hesse's reanalysis of Ganj Dareh. The new archaeozoological data from Qaleh Rostam also suggest the northern diffusion of sheep, initially domesticated in the West.

Demographic data based on an extensive analysis of tooth eruption and wear indicate that caprine economical husbandry was focused on a mixed exploitation of animal products (meat, milk and fleece or hair). The evidence for milk exploitation both from sheep and goat in such an early phase is a significant result of this study. The archaeozoological results combined with palaeoenvironmental, geographical and archaeological data may suggest that the economy at Qaleh Rostam was one of transhumant/nomadic pastoralism. This sheds new light on the long history of this social system as our data predates previously documented cases in this region. The Bakhtiari is still home to many nomadic communities today.

Keywords Iran, Zagros, Domestication, Middle Neolithic, *Capra*, *Ovis*, Pastoral Mobility

Background of the site

Qaleh Rostam is located in the plain of Xana Mirza, 2000m above sea level in the Zagros mountains of modern *Bakhtiari* region in western Iran (Fig. 4.1).

The site is situated on a small flat outcrop, overhanging the mouth of the plain, which offers the site a privileged location. Two small sondages were excavated (Fig. 4.2) by a German team in 1975, directed by H. Nissen and A. Zagarell (Zagarell 1975; 1982; Nissen & Zagarell 1976).

There is no clear evidence for any built structures; only a probable terracing wall was found between the two trenches (Nissen & Zagarell 1976; Zagarell 1982; Bernbeck 1989; pers. comm.). Without further excavations, there is not enough evidence to claim there were no permanent structures.

According to the ceramic assemblage, the stratigraphic sequence is divided into three main phases of occupation (Fig. 4.3).

Several radiocarbon dates have been obtained; there are still some pending due to dispute regarding the date of the upper level of the phase I₁ (Table 4.1). It is noteworthy that the oldest phases of occupation were very close in time, as in technological base of pottery. They concern the first half part of the 7th millennium BC. Even if the change is quite abrupt, especially in the ceramic pattern (Bernbeck 1989; 1999; pers. comm.), phase I still belongs to the same millennium and seems to continue until its very end.

Therefore, the site of Qaleh Rostam begins at the start of the 7th millennium BC and is firmly placed in the Middle Neolithic, namely at the transition phase between Aceramic and Ceramic Neolithic. Qaleh Rostam appears to be unique in the region and anywhere else, especially the ceramic pattern of phase I, which includes highly structured sets of decoration that are characterised by unusual frontal depictions of human faces (Bernbeck 1989; 1999; pers. comm.). Nevertheless, for the phases III and II there are some parallels with Guran (*Luristan*) and Sarab (*Kermanshah*) and for the phase I with Mushki (*Fars*). Consequently one could assume that Qaleh Rostam seems to have been part of a Middle Neolithic complex or even Late Neolithic during phase I (Fig. 4.4, *ibid.*).

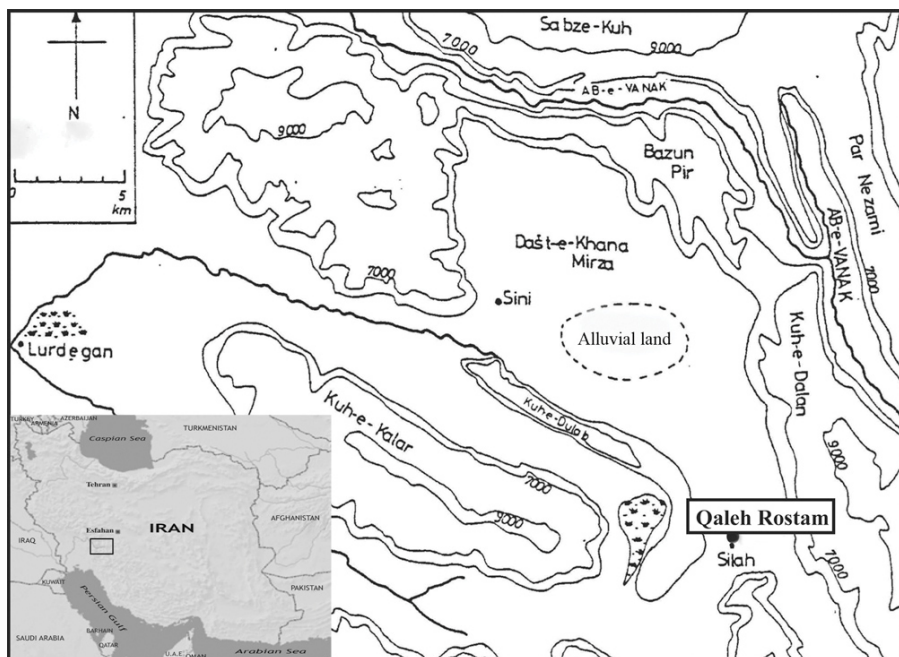


Fig. 4.1. Situation of Qaleh Rostam in the Xana Mirza plain (according to Bernbeck 1989).

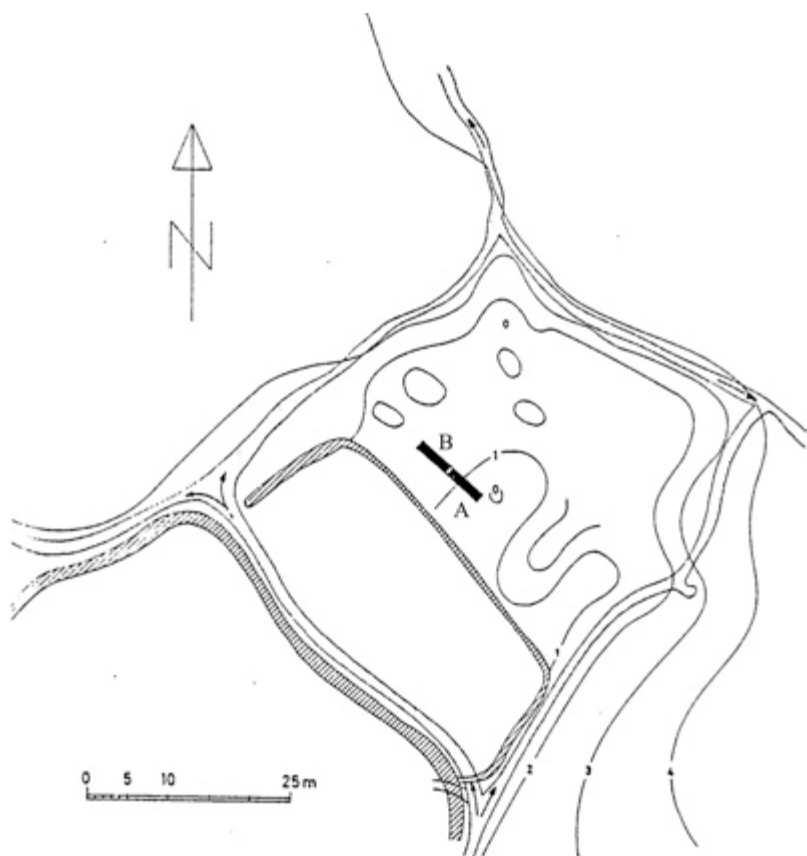


Fig. 4.2. Plan of Qaleh Rostam showing the two sondages (according to Bernbeck 1989).

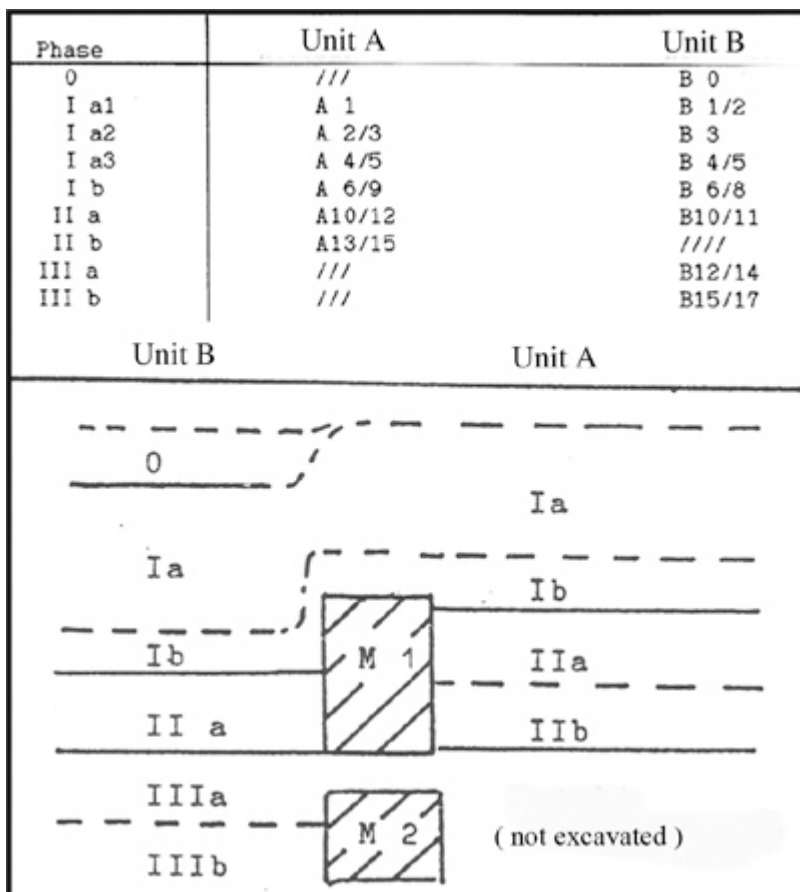


Fig. 4.3. Top: Distribution of the stratigraphic units defined for the two sondages with correlations of phases; Bottom: Distribution of the sub-phases and phases in each sondage on each side of the walls (according to Bernbeck 1989).

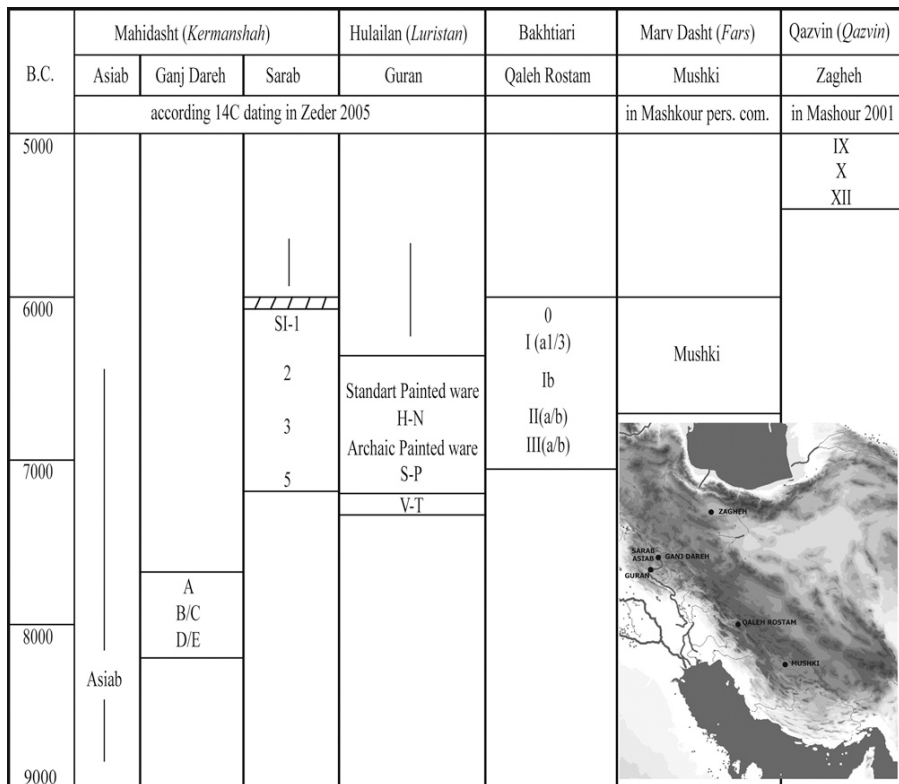


Fig. 4.4. Relative chronology of archaeological sites in the Zagros.

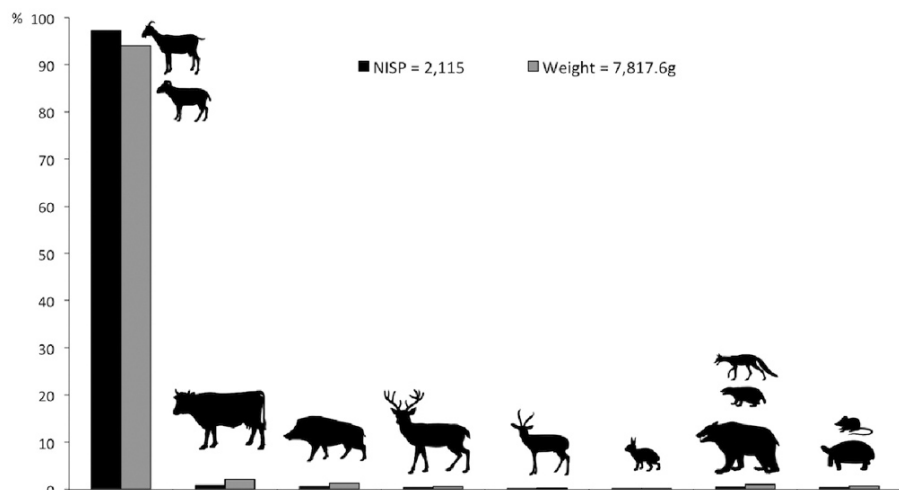


Fig. 4.5. Faunal spectrum in percentage of the NISP and the weight.

Table 4.1. Radiocarbon dates from Qaleh Rostam (all dates are calibrated with Calib. Rev. 5.0.1 (Stuiver & Reimer 1993, Radiocarbon 35: 215–

230, using *IntCal04* calibration curves Reimer et al. 2004, *Radiocarbon* 46: 1029–1058); performed by 14Chrono Centre Queens University of Belfast and sponsored by the UMR 7209 CNRS/MNHN).

Lab No	Phase	Layer	Determination BP	1 SD cal. BC	2 SD cal. BC	AMS $\delta^{13}C$
AA56860	IIIb	B16	7980±75	7045–6806	7066–6677	
UBA-8076	IIb	A14	7988±39	7041–6829	7054–6754	–21.4
UBA-10620	IIa	A12	7877±25	6749–6652	6813–6645	–17.0
UBA-10621	IIa	B10	7943±45	7025–6702	7036–6690	–22.1
UBA-8077	Ib	B6	7848±39	6749–6636	6820–6596	–22.0
UBA-10622	Ia(3)	A4	7345±62	6329–6094	6368–6071	–25.1
UBA-9977	0	A0	7228±27	6200–6031	6208–6022	–14.8
UBA-10623	Ia(1)	A1	907±32	1044–1169	1036–1208	–22.3

Table 4.2. Representation of different taxa at Qaleh Rostam (# weight inferior to 0.1g; * not counted in the total).

TAXA	NISP	Weight
Goat (<i>Capra</i> sp.)	177	1442.2
Sheep (<i>Ovis</i> sp.)	30	2181.7
Caprines	1849	5630.8
Total Caprines	2056	7351.9
Cattle (<i>Bos</i> sp.)	17	164.9
Wild boar (<i>Sus scrofa</i>)	13	102.1
Cervids	7	43.5
Gazelle (<i>Gazella</i> cf. <i>subgutturosa</i>)	3	21.5
Brown bear (<i>Ursus arctos</i>)	3	55.9
Canids	2	14
Fox (<i>Vulpes</i> spp.)	1	0.6
Badger (<i>Meles meles</i>)	1	1.6
Carnivores	4	7.2
Shrew (<i>Crocidura</i> spp.)	1	0
Hare (<i>Lepus europaeus</i>)	1	0.5
Tortoises	6	53.9
Total identified	2115	7817.6
Humans (<i>Homo sapiens</i>)*	52 (+ 1sk)	529.9
Unidentified		
Large herbivores	8	79.3
Small herbivores	1197	2267.5
Large mammals	12	71.8
Small mammals	2435	3209.1
Micromammals	3	0
Molluscs (bivalves, gastropods,...)	31	0
Indeterminate (cf. shell)	1	0
Total unidentified	3686	5626.2
Total	5801	13,443.8

The archaeozoological analysis of Qaleh Rostam consisted of 5801 animal bones with 2115 that were identified to species (Figs 4.5 and Table 4.2, Daujat 2007). Caprines were the largest contributors with the remaining animal bones representing wild taxa such as wild boar,

cervids, gazelle and hare.

Neolithic's issues in the Zagros area

Archaeozoological studies in the Zagros area concern, on one hand, the first animal domestication by hunter-gatherer groups, and on the other hand, the specification of the economical husbandry towards the formation of the first agro-pastoral communities (Dollfus 1989; Zeder 1999; 2003; 2005; 2008; Zeder & Hesse 2000). The Zagros area is characterised by a considerable mobility of some human groups even today (Barth 1964; Digard 1981; Papoli-Yazdi 1991). The origin of this way of life is still enigmatic. However, this may be verified with new archaeozoological research (Zagarell 1975; 1982; Dyson-Hudson & Dyson-Hudson 1980; Henrickson 1985; Mashkour & Abdi 2002; Abdi 2003; Mashkour 2003).

As a result of the radiocarbon dating of the site, the various sizes of caprine bones – some are very large, the question of the status and their presence in the faunal spectrum of other wild animals, can answer the first question concerning the trend of the subsistence economy practised.

Therefore, research question one addresses the first step of animal domestication and asks if the caprines of Qaleh Rostam were wild or domestic, or both? To answer question two, the LSI (Log Size Index) methods were used, to consider the modification in size (Meadow 1981; 1999; Uerpmann & Uerpmann 1994; Vigne *et al.* 2005) and killoff pattern based on tooth eruption and wear (Ducos 1968; Payne 1973; 1985; Helmer 1995; 2000; Helmer & Vigne 2004; Vigne 1998; Vigne & Helmer 1999; 2007; Vigne *et al.* 2005). Through the extensive analysis of kill-off patterns,² it will be possible to characterise the exploitation of caprines in order to highlight the modalities of occupation.

Animal domestication: the case of caprines

The reanalysis of faunal assemblage, particularly of goats, from Ganj Dareh (*Kermanshah*) by M. Zeder and B. Hesse, has shown that the modification in size is not the only evidence to emphasise initial domestication (Zeder 1999; 2003; 2005; 2008; Zeder & Hesse 2000). It is also important to take into account demographic and sex-specific harvest profiles, provided the assemblage allows for these methods. Thus, a small amount of measurable bones are not really appropriate for sex ratios since 'this technique is best performed on large samples, and requires measurement of both fused and unfused long bones'(Vigne *et al.* 2005, 8).

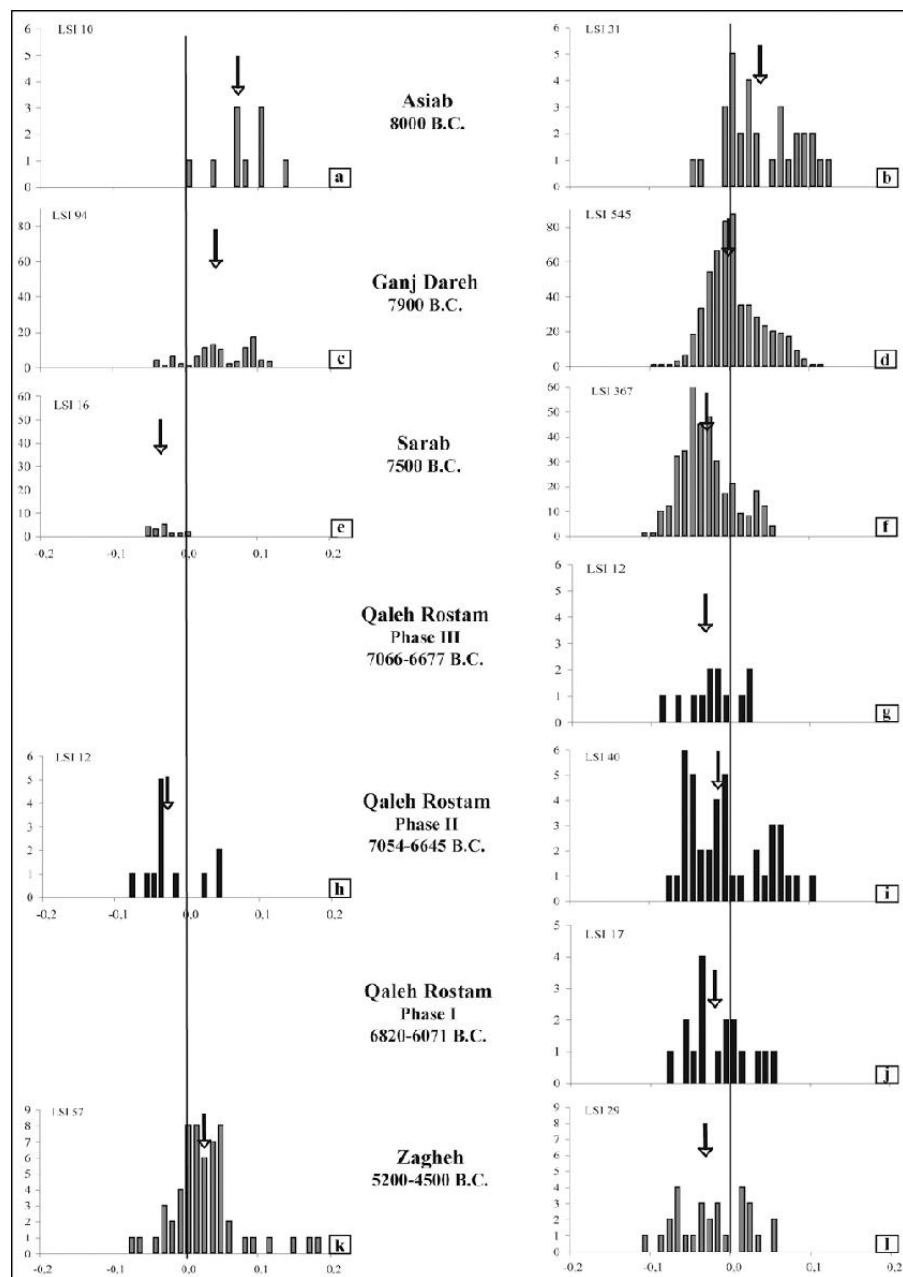


Fig. 4.6. Diachronic comparison of the overall skeletal size of sheep (left column, reference individual) and goats (right column, reference individual) for the Neolithic in Iran (from Uerpmann & Uerpmann 1994).

Log Size Index data from other Neolithic sites of western Iran were used to compare with the assemblage from Qaleh Rostam. This

synthesis is the result of work carried out by M. Mashkour from sites such as Asiab, Ganj Dareh, Sarab (*Kermanshah*) together with her data from Zagheh (*Qazvin*, Mashkour 2001; 2002; for metric data see the Appendix).

Beyond the standard line, a high mean frequency of LSI coupled with slaughter particularly of mature animals, proposes that both sheep and goats at Asiab were hunted (Fig. 4.6a and b). The case however seems different with regard to the sheep and goat populations at Ganj Dareh. The sheep still appear to be wild (Fig. 4.6c). Due to a distinctive culling pattern, the very slight mean reduction of goats shows a management herd strategy rather than a reduction in size (Fig. 4.6d). Indeed, males are slaughtered at young ages while females were allowed to survive through their productive time (Zeder 1999; 2003; 2005; 2008; Zeder & Hesse 2000).

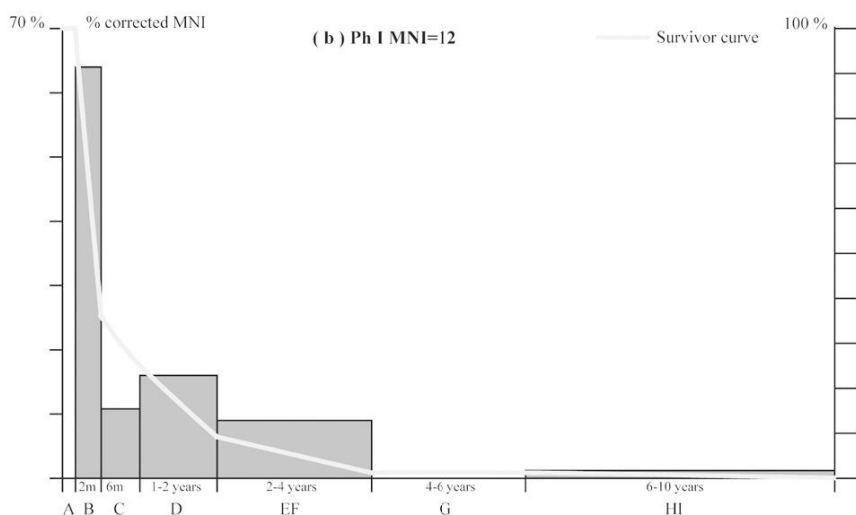
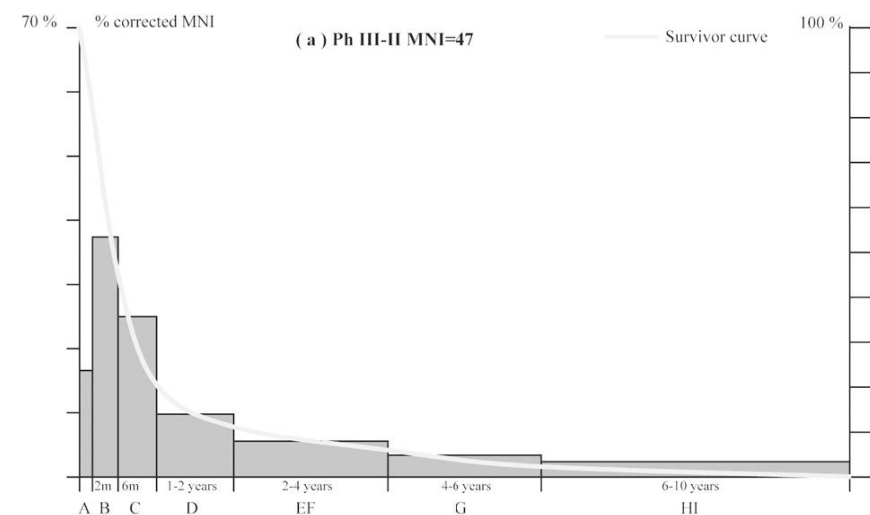


Fig. 4.7. Caprines kill-off pattern for Phase III–II (a) and Phase I (b) at Qaleh Rostam.

The same strategy has to be applied for goats at Sarab, although the reduction in size is much sharper (Fig. 4.6f). However, there is a difference in shift between sheep from Ganj Dareh, whose mean value is high, whereas that of Sarab falls far short of the standard line (Fig. 4.8e). Thus, both sheep and goats seem to represent managed domesticated animals (Zeder & Hesse 2000).

Concerning data from Qaleh Rostam, it is noteworthy that sheep were absent in the earliest phase of the site whereas goats seem to be domestic (Fig. 4.6g). In the next phase, the mean frequency of sheep was similar to that of Sarab. However, this site is dated 500 years

earlier (Fig. 4.6h). As the evidence for goats belonging to phase II was less visible on other sites, there is clear bimodality of frequencies beyond the data of the standard animal, which probably suggests a slaughter of young males and old females (Fig. 4.6i). Moreover, a certain amount of frequencies are well separated from the other group, beyond the standard line that could represent wild animals. Indeed, the setting around Qaleh Rostam could have been frequented repeatedly by herds of wild goats.

There are no sheep bones in the faunal remains of phase I and despite the paucity of data, the results of goats LSI show quite the same pattern than in phase II (Fig. 4.6j).

Almost one millennium later, the mean value of sheep at Zagheh had increased while that of the goat was still the same (Fig. 4.6k and l). This seems to be caused by the exploitation of wild sheep, as the Qazvin plain offers a natural environment. Nevertheless, the kill-off pattern indicates the management of animals (Mashkour 2001; 2002).

Thus, through this diachronic analysis of LSI of some Neolithic sites of western Zagros, a rather different story for the domestication process of both sheep and goat becomes apparent.

Sheep – already domesticated – might have been imported from western regions (Zeder 1999; 2003; 2005; 2008). They appear possibly during phase II at Qaleh Rostam. This is also suggested by the few remains of domestic sheep at Mushki (Mashkour *et al.* 2006, 2007).

Moreover, Qaleh Rostam seems to be in the continuity of the process of goat domestication in the Zagros area, which starts northwards of the site at Ganj Dareh. Thus, the similar mean bone size between Sarab and Qaleh Rostam, and the slightly decreased size in wild animals from Asiab could highlight different scenarios regarding movements of domestic caprine populations and deliberate introgressions of wild animals (Zeder 1999; 2003; 2005; 2008; Zeder & Hesse 2000).

Finally, general kill-off patterns³ definitely confirm the domestic status of most of the caprine population by a selective slaughtering of animals less than 2 years of age, even if there could be some intermingling of wild animals, as is demonstrated by the LSI-analysis (Fig. 4.7a and b).

Estimation of age and seasonality methodologies: difficulties of application to the population of Qaleh Rostam

Both Payne's method on tooth wear pattern of the occlusal surface

(Payne 1973) and Helmer's method (Helmer 1995; 2000; Helmer & Vigne 2004; Vigne & Helmer 2007), a combination of Payne's method (1973) and Ducos' method (1968) on crown height index were employed, first on lower teeth in order to verify the compatibility of results for the estimation of age. The combined results on the analysis of Qaleh Rostam caprine population suggest that Helmer's method tends to overestimate the age as well for a single tooth as for a complete mandible. Even with crown height index established by E. Vila (1998), which baseline population had a more pronounced wear of the crown height, very few teeth have been adjusted when Helmer's class did not agree with Payne's one. However, this method was not completely inapplicable on this material. Since it did not give a different result all the time, it allowed refining the estimation to an age group when the class given by the index was the same as at least one of those defined by Payne's method. In this way each class given for an individual, which is composed of complete or incomplete mandible(s) and/or isolated tooth/teeth, with both methods was counted and the most represented gave the class attributed to the theoretical individual (Daujat unpublished). Given that no method equivalent to the Payne's exists for upper teeth, Helmer's method was used. Since there are age groups that were not represented in the lower teeth; it has been decided to include them in this analysis⁴. Therefore, it is possible that for some upper molars the age was overestimated.

The same problem arose for determining the precise age of the lower fourth deciduous premolars (dP_4) of animals less than 2 years of age, following the method of L. Gourichon (2004). The attribution of age seems to be only coherent from the class D (Fig. 4.8). The group C is not represented at all by measurable teeth. Thus, it is not possible to know since when the results do not fit between the degree of tooth wear and the age given by Gourichon's method. However, it is clear that for the class B there is a huge error margin from 6–7 months more for teeth closer to the earliest limit of this group (2 months) and from 2–7 months for teeth closer to the oldest limit (6 months). And since many dP_4 are fragmented and do not allow taking all possible measurements⁵, we did not consider applying the mathematical model to this population. Moreover, despite the fact that remains of complete mandibles of animals under 2 years of age are so rare, the possibility to obtain a reliable pattern of tooth eruption and wear for this population does not exist for the moment.

Thus, a large variability of the wear of the crown height, and perhaps also of the eruption on one hand, seems to characterise this

assemblage of teeth. On the other hand, the problems met with the methodologies of estimation of age, highlighted that this population may have had a lower crown height than those used for the implementation of these methods. However, the distribution of the anterior vestibular height (HVA)/transverse diameter (DT) ratio of the dP₄ (Fig. 4.8) shows a kind of seasonality pattern, which gives more distinguishable groups than with the median or the posterior lobe for instance (Daujat unpublished). It moreover seems that using this ratio is more reliable than using only the crown height due to the variability of the wear. Indeed, the anterior and median height of the dP₄ of the mandible 249 is lower than that of 461 and even lower than the mandible 654 and yet, the first molar of this mandible is less worn than the two others and has perhaps a wear pattern closer to the group C. The HVA/DT ratio sorts out this dP₄ that is possibly younger than the mandibles 461 and 654.

Here, the use of existing methodologies shows a limited application all the more since they are based on specific references, which seem to be very different from the population of Qaleh Rostam, and unfortunately the data are not very abundant. That is the reason why the interpretation of both kill-off pattern and seasonality has to be really moderated.

Phase	Ref	O/C	lat	Measurements of Dp4				Payne's method (1973)		HVA/DT	Remarks	Gourichon's method (2004)		
				HVA	HVM	HVP	DT	wear stage	age groups			HVM	HVP	Average
III	249	C	D	5,4	5,8	6,2	6,2		D - 1-2 years	0,87	Mandible = M1 CD (C)	17,68	18,50	18,1
III	412	C	D		6,3				D - 1-2 years		isolated		18,56	
III	461	C	G	5,6	6,4	7,8	7,3		D - 1-2 years	0,77	rhizalysed roots Mandible = M1 CD (D)	16,70	16,15	16,4
II	2731	C	D			12,6			B - 2-6 months		isolated		9,10	
II	2733	O/C	D	10		12,9			B - 2-6 months		isolated		8,65	
II	652	C	G						B - 2-6 months		Mandible = M1 (B 3-4 months)			
II	756	O/C	G	9,3					B - 2-6 months		Mandible			
II	653	C	G	9	10,4	12,2	6,6		B - 2-6 months	1,36	Mandible	10,16	9,68	9,9
II	2732	O/C	D	9	11,4				B - 2-6 months		isolated	8,53		
II	650	C	G	7,8	8,6	9,8	6,7		B - 2-6 months	1,16	Mandible	13,10	13,21	13,2
II	744	O/C	G						BC - 2-12 months					
II	2725	O/C	D						BC - 2-12 months					
II	654	O/C	D	5	6,3	7,1	6,7		D - 1-2 years	0,75	rhizalysed roots Mandible = P4 bud+M1 D	16,86	17,18	17,0
II	3937	O/C	D	3,6					D - 1-2 years		isolated			
I	4496	C	G		11,3	12,5			B - 2-6 months		Isolated Large individual	8,69	9,24	
I	4508	O/C	D	9,4					B - 2-6 months		isolated			
I	4498	C	G	8,3	9,5	10,7	6,4		B - 2-6 months	1,30	isolated	11,63	11,89	11,8
I	4492	C	D	8,2	9	9,8	7,1		B - 2-6 months	1,15	isolated	12,45	13,21	12,8
I	4208	C	D	5,7	6,7	8,7	7,1		D - 1-2 years	0,80	Mandible	16,21	14,83	15,5
I	4507	C	D	2,9	4,4	5	7,1		D - 1-2 years	0,41	Isolated = roots not completely rhizalysed	19,97	20,27	20,1

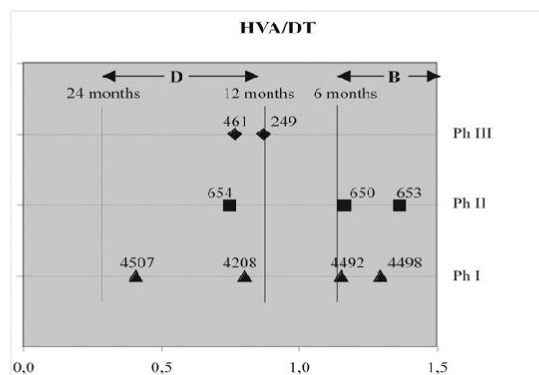


Fig. 4.8. Top: Estimation of age based on tooth wear of the occlusal surface and the crown height of dP₄ of caprines. The grey part depicted on wear stage represents missing parts of the dP₄; Bottom: Dispersion of dP₄ of caprines based on the anterior vestibular height (HVA)/transverse diameter (DT) ratio.

Pastoralism/settlement and the seasonality of occupation: herd management

The culling patterns of sheep and goats highlight a slighter differential

exploitation of both species. Nevertheless, the data regarding sheep and goats specifically are not extensive, particularly for sheep in phase II, and rather highlights the general tendencies of caprine exploitation.

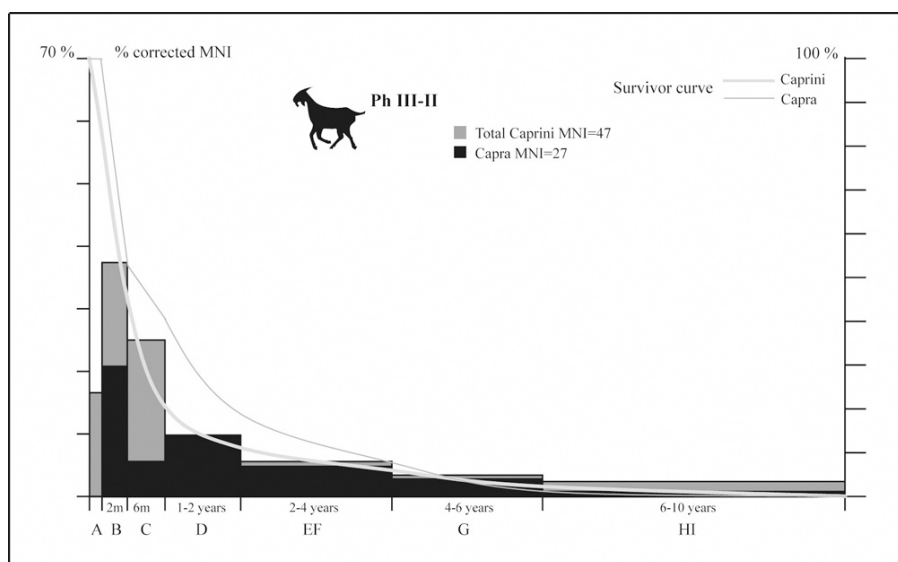


Fig. 4.9. Kill-off pattern of goat for Phase III-II at Qaleh Rostam.

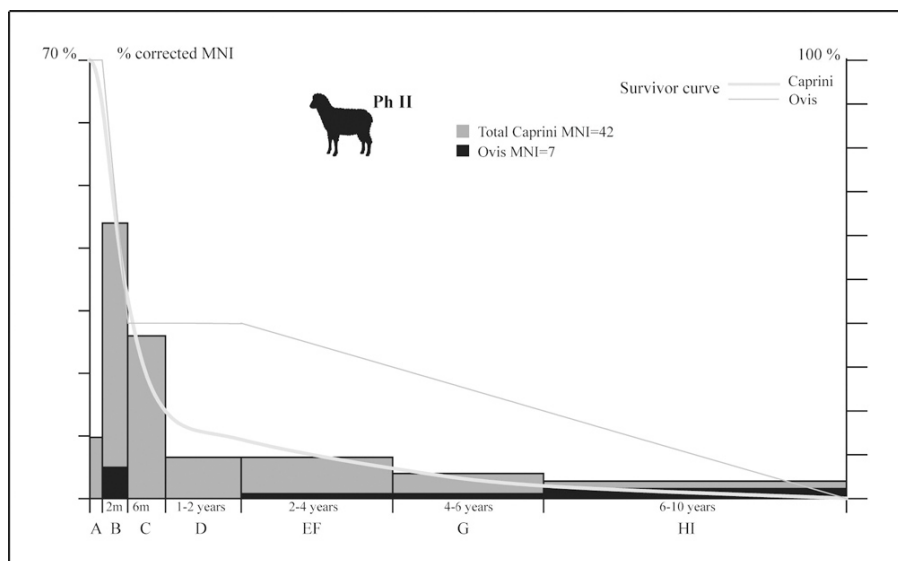


Fig. 4.10. Kill-off pattern of sheep for Phase III-II at Qaleh Rostam.

During phase III-II, the majority of the goats were killed less than 2 years of age (Fig. 4.9) and more specifically between 2 and 6 months. Thus, the slaughter of very young animals (class B), in order to limit

suckling, coupled with the slaughter of cull goats (2–4 = class EF and also 4–6 = class G) stresses milk exploitation (milk B type: Payne 1973; Halstead 1998; Blaise 2005; 2006, Helmer 2000; Helmer & Vigne 2004; Vigne & Helmer 2007). The importance of class B added with some young goats killed between 6 and 12 months (class C) for an optimum weight also emphasises a production of tender meat (meat A model: Payne 1973; Helmer 2000; Helmer & Vigne 2004; Vigne & Helmer 2007). As there are remains from probable wild animals in the assemblage (see above), they could have been represented in the percentage of the class D. Actually this class usually indicates a high weight efficiency exploitation of adults' meat. It could also be the animals killed for the herd's control. However, even if class D is mostly represented by goats, their importance in the class B and particularly in class C could be increased as it is suggested in the general kill-off pattern. The lowest represented classes G–HI could reflect an interest for hair (?) and/or tallied with a reproductive pool.

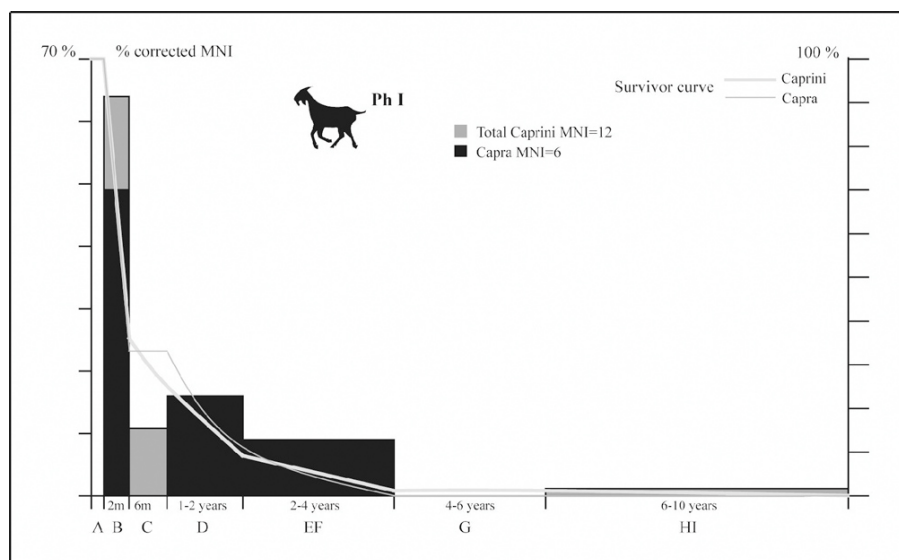


Fig. 4.11. Kill-off pattern of goat for Phase I at Qaleh Rostam.

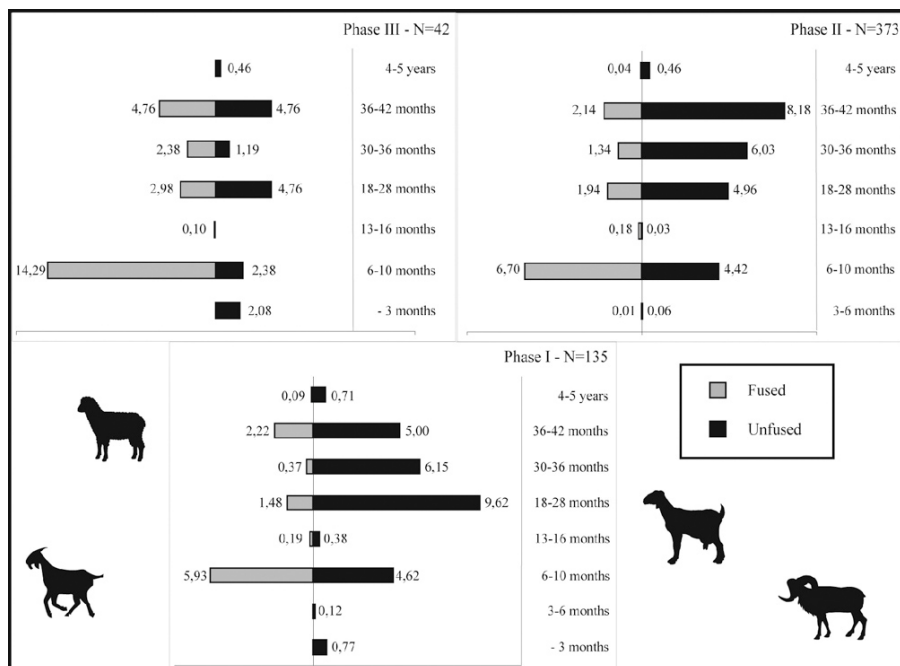


Fig. 4.12. Distribution of caprine bones according to fusion stages at Qaleh Rostam (for the method after Silver 1969, Vigne 1988).

Despite the small number of individuals for sheep, the kill-off pattern does not differ considerably from that of the goats (Fig. 4.10). As for the goats, the slaughter of very young animals belonging to class B could suggest the exploitation of tender meat production (meat A model: *ibid.*), but still coupled with class EF and to a lesser extent class G, highlights the importance of the milk products (milk B model). Whilst no sheep are represented in class D, there might be a few amongst class C unidentified caprines. This would mean that exploitation of young sheep would be oriented toward a weight optimum, as opposed to a maximum weight efficiency, and a preference for tender meat expressed. Conversely to the culling of goats, the oldest part of the sheep herd is overwhelmingly represented, which could be an evidence for the exploitation of fleece (class HI).

Unfortunately, only the kill-off pattern for goats was obtained for phase I since there are no sheep. This profile shows very little change in the exploitation between this and the previous phases (Fig. 4.11). Animals were still killed mostly between 2 and 6 months. The milk exploitation (milk B model) is clearly emphasised by the culling of very young animals (class B: limitation of suckling), and also the class

EF (Payne 1973; Halstead 1998; Blaise 2005; 2006; Helmer & Vigne 2004; Vigne & Helmer 2007). Contrary to the oldest phases, the meat exploitation is focused on a maximum weight efficiency (class D, meat B type). Finally, no old goats seemed to have been killed on the site unless they are assimilated to the few caprines of the class HI. However, as there were very few teeth for this phase, it is quite well possible that older animals, as the class G, are missing like sheep teeth. Despite a very low number of individuals, it is noteworthy the class A is not represented at all whereas it was for the oldest phase at least for caprines without species distinction.

Thus, from the results of kill-off patterns of sheep and goats, it appears that economical husbandry of caprines was focused on a mixed exploitation of animal products. Coupled with other factors such as the geographical situation, and the nature of agricultural activities, the data from faunal analysis suggest that the economy practised at Qaleh Rostam may have been a certain kind of pastoralism (Daujat unpublished, see also Daujat *et al.* 2016).

Regarding the seasonality of occupation at the site, the scarcity of reliable data does not help in its interpretation. According to fusion data from post-cranial elements, the trend is more or less the same in all the three phases, i.e. the peaks always highlight at least a passage in the spring and autumn (Fig. 4.12). It is noteworthy that in post-cranial elements there were premature caprine bones with at least one in its last period of development⁶. As few isolated examples, this could be rather a natural delayed birth than suggesting births occurred at the site. The post-cranial data of phase II highlight an absence of newborn caprines but there is one unworn upper teeth that proves the contrary. The kill-off profile of phase I has shown an absence of dead animals between 0 and 2 months (see above). Thus the combination of both teeth and post-cranial data evidence the gaps in each analysis here (Fig. 4.13). But the interpretation is not simple due to the difficulties of these methods, i.e. for the dP₄ analysis the problems of application to the population of Qaleh Rostam (see above) and for the post-cranial analysis the imprecision of age. However, we could consider that births occurred in April in such early period, i.e. the beginning of spring (Bökönyi 1992) and we could retime post-cranial data link to the teeth. It is clear that there was a movement of a human group, which occupied the site of Qaleh Rostam. The trend is more obvious for phase II but it is possible from a phase to another that the occupation of the site differs slightly, maybe particularly regarding to the presence of wild animals in the area. Thus, the group could have been present on the site throughout spring time and

whether they stayed on during summer until the beginning of autumn, moving around a base camp, or just passed in the spring and at the beginning of autumn. Nevertheless, it is possible that young animals could have been slaughtered, according to human needs, going to or from summer pastures and, maybe mostly on the way back when they have been fattened, as observed in the Bakhtiari tribe (Digard 1981).

Considering particularly the lack of architectural structures and a pattern of movement that suggests the possible occupation of the site at least in spring and autumn, we propose the term of ‘transhumant’ pastoralism or even ‘vertical transhumance’ can be used with reference to this site (Daujat unpublished, qualified statement in Daujat *et al.* 2016). Without the intention to oversimplify possible parallels between prehistoric societies and modern Bakhtiari’s tribes, the region still is characterised by an important West-East transhumant mobility of human groups (Digard 1981; Zagarell 1982; Mashkour 2003). Thus, since the rise of agro-pastoral communities in the Zagros area, this way of life, despite different forms of pastoralism and their changes over time, always have been dictated by geographical and environmental conditions, for which caprine exploitation and seasonal movements are the most suitable.

Conclusions and prospects

To conclude, caprines are represented by domestic sheep and goats, with the main focus on goats. The management system for livestock appears directed to pastoralism with the exploitation of mixed products and especially dairy products, following the idea that the ‘[...] “secondary products”, especially milk, did not appear secondarily’ (Vigne & Helmer 2007, 33). Despite the imprecision of data regarding references used in estimation of age methodologies, the site seems to be seasonally occupied by human group(s) practising ‘transhumance’, i.e. either the site was a passage and stopping place before reaching the high summer areas or that it was a summer camp for more than three months. In order to verify the seasonality of culling and for a better understanding of the pastoralism practised at Qaleh Rostam, we propose to carry out isotopic analysis on the teeth.

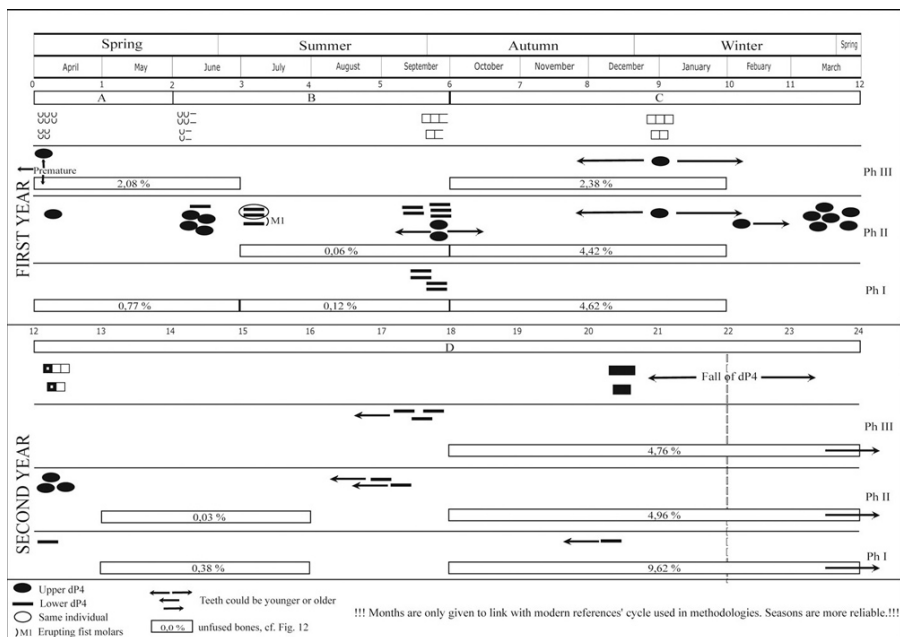


Fig. 4.13 Retiming of tooth and post-cranial data according to season of caprines' birth (after Silver 1969, Vigne 1988).

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Notes

- 1 The radiocarbon date of A1/UBA-10623 (AD 1036–1208) that seems to correspond with the disturbance of the Unit A by an Islamic grave. This unit contains a large amount of late Neolithic pottery, which further verifies this date to be the result of disturbance (Bernbeck pers. comm.).
- 2 Despite the few number of individuals obtained, kill-off patterns are presented in MNI. Indeed, even if the (number of teeth) limit the dissociation effect (Vigne 1988), it underestimates young animals which had to be highly considered in this study.
- 3 They were gathered for the two oldest phases because of the lack of data, for a better visual representation (only seven individuals for phase III).
- 4 For instance, in phases III and II, the group A was not represented by lower teeth; the group C was mostly increased by upper teeth; in phase I the only tooth, which belongs to the class C, was an upper tooth (Daujat unpublished). Upper teeth for phase III represent four individuals, for phase II, 20 individuals, and one individual for phase I.
- 5 There are only nine completely measurable dP4 out of 20 altogether.

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Appendix. Measurements of measurable elements of each anatomical part. Measurements following von den Driesch (1976). Additional measurements: scapula (LCG: Buitenhuis 1995); humerus (DTT/HT: Helmer & Rocheteau 1994, Ht: Fernandez 2001); metapods (Wt/Wc: Payne 1969).

Additional measurements							
Scapula	LCG		Buitenhuis 1995				
Humerus	DTT/HT		Helmer & Rocheteau 1994				
	Ht		Fernandez 2001				
Metapods	Wt/Wc		Payne 1969				
	(m=medial/l=lateral)						
Horn cores	Reference	Phase	40	41	42		
<i>Capra</i> sp.	A12 #540	II	96.5	35	24.7		
<i>Ovis</i> sp.	A10 #37	II	145	52.8	36.7		
	A12 #541	II		52.9			
Cranium	Reference	Phase	27	29	30		
<i>Capra</i> sp.	A12 #505	II	48.3	21.8	19.9		
	A12 #506	II	49.3	20	20		
	A13	II	47.6		18.1		
	#1959						
Mandible	Reference	Phase	7	8	9	11	15b 15c
Caprini	A11 #145	II	75.5	50.6		33.8	21.8 15
<i>Capra</i> sp.	A7 #4076	II			25	31.2	22.2 14.7
	A12 #647	II			24.9	45	20.7 14.9
	A12 #648	II			28.5		
	A12 #659	II					15.7

Scapula	Reference	Phase	LCG	GLP	LG	BG	SLC	HS
Caprini	A1 #4316	I	27.4			22.1	21.5	
	A1 #4319	I			32.5		23.1	
	B8 #3979	I					27.4	
<i>Capra</i> sp.	A1 #4320	I	26.4	31.5	23.4	21	21.5	
	A3 #4186	I	26.4	30.6	21.4	21.1	19.3	153
	A12 #1235	II	28.4	34	28.9	23.1		
	A12 #1237	II	30.8			23.3	20.2	
	A12 #1238	II		30.7	25.4	22.8		
	A12 #1239	II	25.7	29.4		21.6	17.8	
	A12 #1240	II	28.2			20.4	19.7	
	A 12 #1241	II	30.5	37.6	30.6	27.1	21.3	
	A12 #1242	II		31.7	26	22.7	23.7	
	A13 #2061	II	29.3	31.4	27.4	22.6	22.2	
	A13 #2068	II	25	34.3	29.5			
	A14 #2541	II	32.4				21.7	
	A14 #2544	II	26.3	30.7	25.1	22.1	20.2	
	B11 #209	II	35.9	41.4	32.7	26.8	25.7	
	B12 #477	III		31.2	25.6	23.7	20.4	
	B14 #1450	III	27.2			20		
<i>Ovis</i> sp.	A12 #1236	II		30	24.6	20.4	19.4	
Humerus	Reference	Phase	Bd	Dd	BT	HT	Ht	
<i>Capra</i> sp.	A1 #4269	I			30.4	17.6		
	A5 #4131	I			33.4	20.1		
	A12 #903	II	39.7		39.5	24.5	16.3	
	A12 #904	II	38.2	30.5	35.6	20.5	15.8	
	A12 #906	II	30.9	24.9	30	18	13.7	
	A12 #907	II	30.3	26.1	29.7	17.8	13.4	
	A12 #908	II			28.7	17		
	A12 #909	II	32.4	27.8	31.2	20	15.7	
	A12 #910	II	30.4		30.2	17.1	13.3	
	A12 #911	II		27.9	33.7	19.5	14.5	
	A12 #912	II	31	24.1	30.1	18	13.3	
	A13 #2080	II	34	26.5	32.5	19.4	13.9	
	B10 #123	II	41.8	33.7	41.1	24.3	18.6	
	B17 #442	III	36		35.4	21	15.3	

Radius	Reference	Phase	Bp	Dp	Bfp	Bd	Dd	Bfd
Capra sp.	A1 #4293	I	32.4		31			
	A1 #4296	I				32.9	20	28
	B6 #4033	I	40.4	18.6	37			
	A11 #194	II				37.4	24.1	31
	A12 #843	II				41	24.9	34.1
	B16 #1372	III	30.1	15.1	28.4			
Ovis sp.	B16 #1377	III	32	16.2	29.5			
	A12 #848	II	29.4	15.6	28.2			
Ulna	Reference	Phase	DPA	SDO	BCP			
Caprini	A14 #2601	II	26.2		23.2			
cf. Capra	A14 #2599	II	23.6	20.2				
Capra sp.	A1 #4293	I	28.2	23.1	23.4	with Rd unfused (with epiphysis)		
	A12 #826	II	28.6	23.7	22.8			
	A12 #833	II	24.7	21.4	21.4			
	B10 #108	II		25.5	25.3			
Ovis sp.	A12 #836	II	28.7		20			
	A12 #837	II	24.8	20.4	18.3			
Carpal	Reference	Phase	GB	(capitato-trapezoid)				
Caprini	A12 #1103	II	18.3					
	A12 #1104	II	15.9					
	A14 #2644	II	15					
	B16 #423	III	15.7					
Metacarpus	Reference	Phase	Bd	Dd	Wcm	Wtm	Wcl	Wtl
Capra sp.	A1 #4377	I	31.8	18	10.9	14.3	10.2	13.9
	A1 #4378	I	27.6	16.8	10.3	12.6	9.6	12.3
Femur	Reference	Phase	Bp	SD	DC			
Caprini	A12 #956	II			21.4	head head		
	A12 #957	II			20.8			
	A12 #958	II	41.2		20.1	unfused		
	A12 #985	II		21.4				
Tibia	Reference	Phase	Bd	Dd	GD			
Caprini	A2 #4198	I	24.1	20.5				
	B10 #132	II	28.3	22.1				
	A12 #1050	II	24.9					
	A12 #1051	II	27.9		16.6			
	A13 #2125	II	26.7					
	A14 #2627	II	26.7					
	A14 #2632	II			13.5			
	B12 #497	III	32.4	24.4				

Talus	Reference	Phase	Bd	GLm	GLl	DI	Dm	
<i>Capra</i> sp.	B6 #4032	I	23	29.3	31	17		
	B8 #3981	I	21	31.5		19	18.8	
	A11 #190	II	17.1	25.4	26.8	14.4	15.1	
	A12 #1079	II	19.4	28	30.2	16.1	17.3	
	A12 #1080	II	17.3	27	27.6	14.7	15	
	A12 #1082	II		26.2		15.1		
	A13 #2146	II	20.1	28	30.5	16.7	18.1	
	A13 #2147	II	20.4	27.3	29.8	16.4	17.1	
	A13 #2148	II		27.5			15.5	
	B11 #216	II	17.9	26.1	28	15.5	16.3	
	B15 #242	III	21.8	30.5	32.4	18.1	18.2	
	B14 #252	III	21.3	31.3	32.5	17.5	18.6	
	B16 #436	III	19.8	28.5	30.7	17.2	17.3	
	B16 #437	III	18.7	28.6	30.6	16.1		
	B12 #503	III	20.4	28.7	30	16.5	17.3	
<i>Ovis</i> sp.	A12 #1078	II	17.4	25.8	27	14.2	14	
	A12 #1081	II		26		15		
	A12 #1083	II		27.3		15.5	15.6	
	A12 #1084	II	18.1	26.6	28.9	15.4	15.9	
	A13 #2144	II	18.4	26.8		15.4	16	
	A13 #2145	II	17.7	27.7	28.7	15.1	15.7	
Metatarsus	Reference	Phase	Bd	Dd	Wcm	Wtm	Wcl	Wtl
<i>Capra</i> sp ?	A14 #2679	II	32.6	17.6	12.2	13.6	12.6	14
<i>Capra</i> sp.	A12 #1158	II	31.3	21	13.8	14.7	13.2	13.9
Metapod	Reference	Phase	Bd	Dd	Wcm	Wtm	Wcl	Wtm
<i>Capra</i> sp.	A14 #2671	II	24.7	15.3	9.5	10.9	9	10.8
	A10 #5	II	34.2	20.2	12.6	15.5	12.7	15.1
<i>Ovis</i> sp.	A12 #1159	II	24.7	15.3	9.5	10.9	9	10.8
Phalanx I	Reference	Phase	Bp	Dp	Bd	Dd	SD	Glpe
Caprini	A14 #2692	II	10					
<i>Capra</i> sp.	A1 #4248	I	13.1	16.3	13.5	11	11.1	40.7
	A4 #4143	I			11	9.6	9.5	
	A13 #2157	II	12.9	15.7	12.9	10.4	10	
	B6 #4030	I	12.5	15.1	13.2	11.4	12.3	30
	B6 #4031	I	14.9		15.3	13.3	13.2	
	A11 #191	II	12.8	15.8	12.5	10.1	11.1	34.2
	A11 #192	II			11.9	11.2		
	A 12 #1108	II	13	15.5	13.6	10.5	11.4	36.1
	A12 #1110	II	12	14.7	12	10.1	9.8	35.4
	A13 #2155	II	15.2	20.6	16.7	12.8	13.7	42.2
	A13 #2156	II			14.9	13.3	13	
	A14 #2689	II	14.2	17.5	15	13.2	13.1	
	A14 #2690	II			15.7	13		
	A15 #400	II			14.2	12.4		
	B15 #285	III	13.1	12.9	12.9	10.2	10.4	37.4
	B17 #452	III			12.5	10.5		
<i>Ovis</i> sp.	A12 #1111	II	9.9	11.9	10	8.6	8.3	31.8

Phalanx II	Reference	Phase	Bp	Dp	Bd	Dd	SD	Glpe	
Caprini	A1 #4254	I	8.5	9.5	6.5	8.6	6.4	17	unfused
Capra sp.	A1 #4251	I	12	13.6	10.3	11.2	9	22.6	unfused
	A1 #4252	I	12	13.6	10.3	11.3	9.3	23.2	unfused
	A12 #1112	II	14.5	15	11.9	12.7	11.2		unfused
	A15 #402	II	16.9				11.1		
Ovis sp.	A15 #401	II	14.2		12		10.9	28.5	
	A12 #1113	II	13.7		11		9.8	29.2	
	A12 #1116	II	14	15	11.7	11.6	9.5	28.7	
Phalanx III	Reference	Phase	DLS	LD	MBS				
Caprini	A11 #193	II	20.8	16.6	2.6				
Capra sp.	A1 #4242	I	29.8	21.3	5.1				
	A1 #4243	I	23.1	15.7	3.8				
	A1 #4244	I	23.9	16.8	3.8				
	B8 #3980	I			5.7				
	A12 #1117	II	32.9	25.3	5.8				
Ovis sp.	A15 #403	II	30.1	24.5	5				

5. Digesting the data: dogs as taphonomic agents at Neolithic Çatalhöyük, Turkey

Nerissa Russell and Katheryn C. Twiss

Dogs have long been shown to be a significant taphonomic factor wherever they are present. Often this is approached in terms of density-mediated attrition, with dogs as a key attritional agent. Here we focus not on what is missing, but on what is present: digested bone derived from dog feces, in particular its spatial distribution. We discuss remains from Neolithic Çatalhöyük, where digestion affects a substantial proportion of some skeletal elements (e.g., sheep/goat phalanges) and not others.

By their nature, dog feces generally form secondary deposits, away from the bones' original places of discard. Moreover, at Çatalhöyük dog feces are often gathered and dumped in concentrated areas, placing them in tertiary context. Dog consumption and excretion thus potentially have a substantial effect on the spatial distribution of body parts.

We use dog fecal remains to explore human and canine behavior at Çatalhöyük. The contents and placement of dog feces reflect both the access of dogs to various locations and activities around the settlement, and human attitudes toward dogs and their waste. We find that dogs are not in fact moving bones very far, showing that dogs are attached to locations and perhaps households within the site. Dogs do not appear to be cherished companions at the site, but their waste may actually be valued.

Keywords Taphonomy, dog, digestion, Anatolia, Neolithic, human–animal relations

Introduction

In recent decades, zooarchaeologists have devoted considerable

attention to taphonomy as they refine their methods (for overviews, e.g., Gifford 1981; Lyman 1994; Nicholson 2001; Stiner 2008). Initially, taphonomic studies consisted of cautionary tales or correctives intended to counter naïve interpretations of animal remains. Later, taphonomic information was used to provide information about human behavior, such as disposal practices (e.g., Martin & Russell 2000; Meadow 1991; Serjeantson 2000).

In these taphonomic discussions, the activity of dogs has rightfully received much study, showing that dogs can significantly transform faunal assemblages (e.g., Hudson 1993; Kent 1981; Munson 2000; Payne & Munson 1985). Attention has largely focused on dogs as agents of attrition: what they remove. Here we concentrate on what they deposit: the digested bone from their feces that joins the archaeological record. Using midden deposits at Çatalhöyük as a case study, we examine the effects of dog defecation on the animal bone assemblage. In addition to altering the assemblages we study, dog feces provide information on the location of dogs in the settlement. In combination with other information, this can yield insights into human–dog relations and into human as well as dog behavior. In this paper we thus pursue the methodological and interpretive implications of dog location and behavior, as revealed through the distribution of digested bone.

Çatalhöyük

Çatalhöyük is a large Neolithic tell in central Anatolia (Fig. 5.1), dating to ca. 7300–6200 cal BC. It was formed by the rebuilding of closely-packed mudbrick houses. These houses were entered via their roofs; there are no alleys between houses for ground-level travel or building access. However, there are occasional open areas among the houses, created when an abandoned house was not rebuilt for some time; these open areas accumulated rich midden deposits through dumping from nearby occupied houses.



Fig. 5.1. Location of Çatalhöyük in Anatolia.

James Mellaart first excavated Çatalhöyük for four seasons in the 1960s. Work resumed at the site in the 1990s, with an ongoing project directed by Ian Hodder (Çatalhöyük Research Project). For the most part, Mellaart's system of building levels has been used to refer to temporal distinctions within the site, even within the new project. Recently, a revised system of phases has been developed for the South Area (Farid 2008), where both Mellaart and the Çatalhöyük Research Project have excavated (Fig. 5.2). Neither of these systems can be directly linked to other areas of the site, where shallower excavations have not permitted the definition of long sequences, but similar internal phasing systems have been developed for these areas. A focused program of radiocarbon dating now underway should eventually clarify these relationships (Bayliss & Farid 2008); for the moment we have to rely on approximate equivalencies based on artifact typologies.

The animal bones from the 1960s excavations, which have since been lost, were reported briefly by Perkins (1969), while Ducos (1988) produced a more complete report apparently based on a partial sample. Cattle dominated the animal bones recovered from the earlier excavations, but, as Ducos suspected, this was a result of hand picking rather than an accurate representation of the taxa deposited. Screening and flotation in the renewed excavation, which provides the material for this study, has revealed that sheep/goat form ca. 70% of the assemblage for the earlier part of the sequence, rising to 85% by the end of occupation on the Neolithic East Mound (Fig. 5.3). Cattle drop from ca. 20% earlier to ca. 10% later. Equids occur throughout

the sequence, averaging about 5% and also tending to drop in the later levels. Dogs are relatively common, comprising ca. 2–5% of the fauna in the earlier levels, 1–2% later. However, when expressed as densities per volume excavated in midden areas, the proportion of dogs (and most taxa) remains steady, while caprines sharply increase in the later levels. Contrary to Perkins' preliminary report, we now believe that the sheep and goat are domestic (with occasional wild individuals present), while the cattle and all other taxa except dogs are wild for much of the sequence, with domestic cattle appearing by South.P (Russell and Martin 2005, Russell *et al.* 2005; 2013).

Digested bones

When dogs feed, they tend to swallow chunks of food that may contain bones. They also gnaw on bones and swallow bone fragments thus produced. These actions remove bones from assemblages. However, some of these bones pass through the dogs' digestive system and emerge in the feces, bearing signs of alteration by the stomach acids. There have been many studies of the effects of digestion on various types of bones, when swallowed by assorted mammalian carnivores and omnivores or birds of prey (e.g., Andrews 1990; Butler & Schroeder 1998; Fisher 1995; Hockett 1996; Nicholson 2000; Schmitt & Juell 1994; Sutcliffe 1970; Esteban Nadal *et al.* 2010). We are grateful to the brave scientists who have collected feces from animals fed bones to analyze the results, or even swallowed bones themselves and collected the remains at the other end (e.g., Crandall & Stahl 1995; Greenfield 1988; Jones 1986; Payne and Munson 1985; Spennemann 1994).

These studies show that bone that has passed through an animal's digestive system emerges with reduction, thinned edges, pitting, smoothed and often shiny surfaces, and generally showing the signs of having passed through an acid bath (Figs 5.4 and 5.5). Experimental work has also shown that much more is lost to digestion than survives; digested bone fragments constitute only a small portion of the bones consumed (Jones 1986; Munson & Garniewicz 2003; Payne & Munson 1985). Density is a prime variable in determining what survives the digestive tract, and time in the gut also plays a role. The amount of flesh, skin, or cartilage left on the bone when swallowed can have a significant effect, by protecting the bone through part of the digestive process (Esteban Nadal *et al.* 2010).

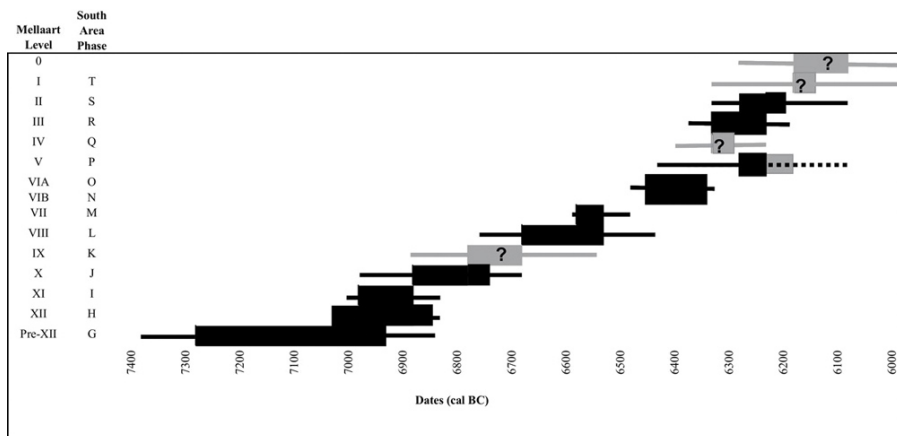


Fig. 5.2 Çatalhöyük South Area stratigraphy (based on Cessford *et al.* 2006 and Farid 2008).

Considerable effort has been devoted to identifying the digester, especially for microfauna concentrations. Generally speaking, bird taxa can be identified as the source of bone accumulations based on the combination of the taxa and body parts present, the damage the bones exhibit, and the degree of digestion (Andrews 1990; Bocheński 2005). Mammalian digesters are distinguished mainly by the size limit of bone fragments they will swallow (Payne & Munson 1985; Schmitt & Juell 1994; Solomon & David 1990; Barja & Corona 2007; Binford 1981; Esteban Nadal *et al.* 2010; Horwitz 1990), although the degree of digestion and of breakage also varies among small carnivores (Matthews 2006; Andrews & Evans 1983).

We believe that dogs are the major, although not sole, source of digested bones at Çatalhöyük (Fig. 5.4). Humans tend to chew before they swallow, and thus swallow only small bone pieces, probably not more than 1cm. Dogs generally swallow bones up to 3–4cm in length, and occasionally as large as 5cm, while wolves may consume pieces as long as 8cm, although possibly the largest pieces are not actually from scats (Table 5.1). At Çatalhöyük the digested bones do not exceed 5cm in length, and most are in the 1–3cm range (Fig. 5.6).

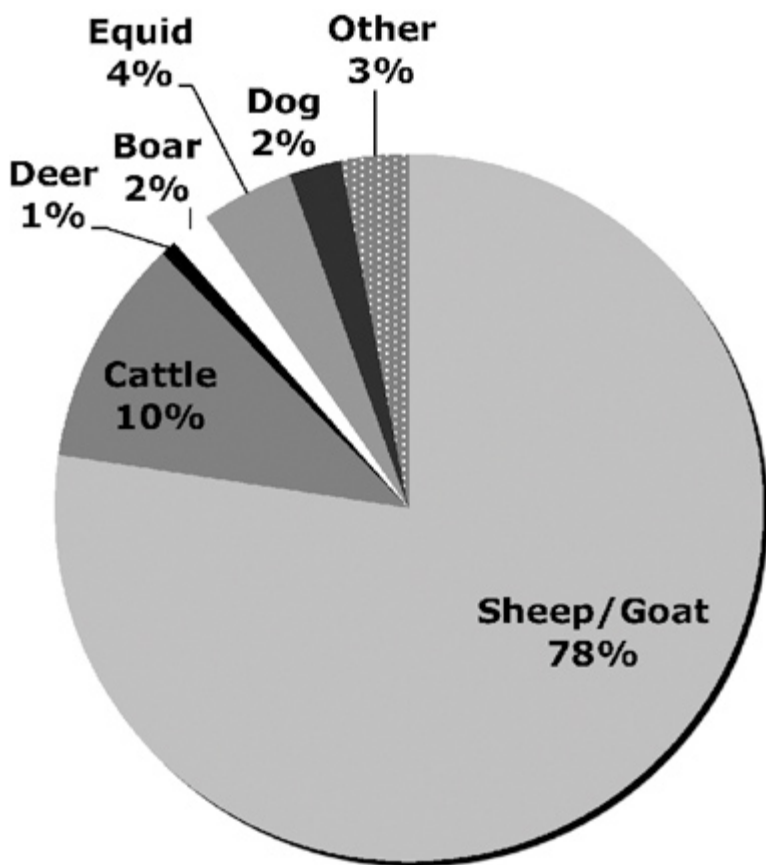


Fig. 5.3. Distribution of identified taxa from Çatalhöyük East Mound by diagnostic zones (Watson 1979).

The dimensions of gnaw marks on bones is related to the tooth size of the gnawer, but imprecisely (Binford 1981; Haynes 1983; Selvaggio & Wilder 2001; Nasti 2000; Elkin & Mondini 2001; Domínguez-Rodrigo & Piqueras 2003; Solomon & David 1990; Coard 2007; Moran & O'Connor 1992; Delaney-Rivera *et al.* 2009). Large teeth can leave small marks, so it is difficult if not impossible to link individual marks to particular species. However, the overall pattern of gnaw mark size corresponds to the tooth size of the gnawer. Specimens covered with small, sharp gnaw marks indicate that smaller carnivores were occasionally present on the site. Large carnivores such as wolves and leopards conceivably could have swallowed bones in the size range of the Çatalhöyük digested bones, but we do not find remains of the upper end of the size range they could swallow. Moreover, the presence of dogs on the site, as well as the sheer concentration of humans, would have prevented wild mammalian carnivores from spending much time there. The majority of gnaw marks are in the dog

size range.

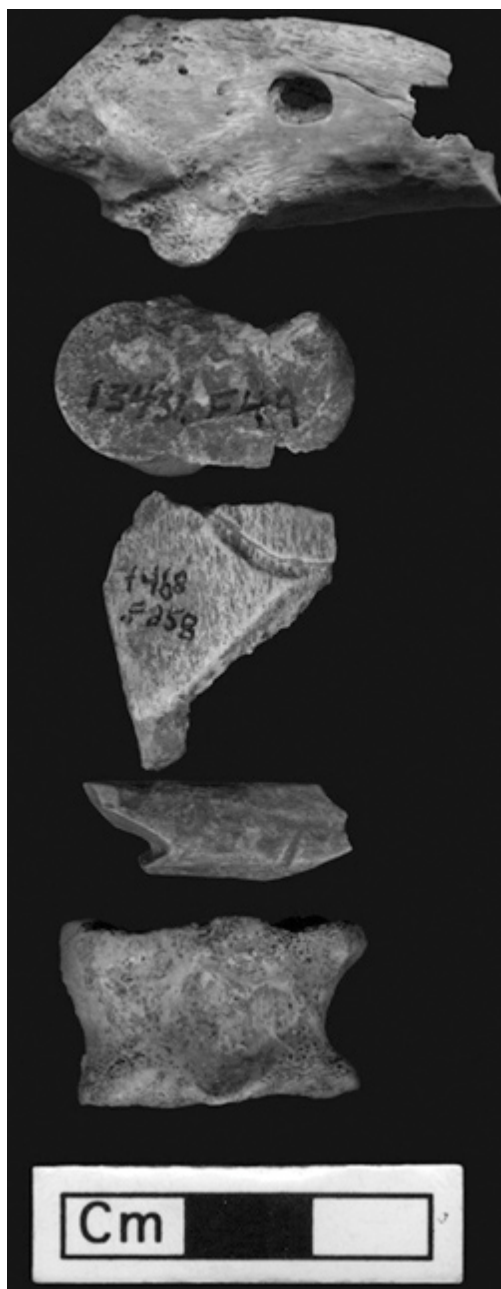


Fig. 5.4. Examples of digested bone from Çatalhöyük.



Fig. 5.5. Caprine phalanges from Unit 16598 showing varying degrees of digestion.

Table 5.1. Studies of bones digested by dogs and wolves

<i>Study</i>	<i>Basis</i>	<i>Size Range</i>	<i>Body Parts</i>	<i>Other</i>
Binford 1981	Collection from wolf den	most <5cm, mainly <3cm; a few <7cm	teeth, phalanges, carpals & tarsals, metapodial condyles, femoral capita	collected from latrine area, may include undigested bones
Payne & Munson 1985	Experiment	<5cm, mostly 0–3cm	varies by animal size; for goat, tend mainly to swallow post-cranial, especially small bones, denser bones survive better	
Jones 1986	Experiment			3–5 days to pass through digestive tract
Klippel <i>et al.</i> 1987	Experiment		phalanges & sesamoids, ribs, vertebrae predominate	fed white-tailed deer to captive wolves
Solomon & David 1990	Experiment	<4cm, mostly 0–3cm		
Horwitz 1990	Study of paleontological & recent hyaena scats; published data; archaeological study	hyaena <3cm, mostly <1cm; dog <5cm, mostly <1cm, few larger than 2cm; wolf <8cm, mostly 0–5cm, tending larger than dog	phalanges, astragali, calcanei predominate among identifiable body parts	
Munson & Garniewicz 2003	Experiment		fed mandibles only	only some feces collected; survival affected by density, size, cooking; creates strong bias against younger specimens
Barja & Corona 2007	Study of recent wolf scats	1–3cm	phalanges, long bones, vertebrae, and astragali predominate	roe deer & wild boar are main prey
Esteban-Nadal <i>et al.</i> 2010	Study of recent wolf scats	<4 cm, mostly 0–2cm	vertebrae, long-bone fragments, phalanges predominate	degree of digestion affected by age of predator, age of prey, type of bone, time in gut, amount of tissue protecting bone

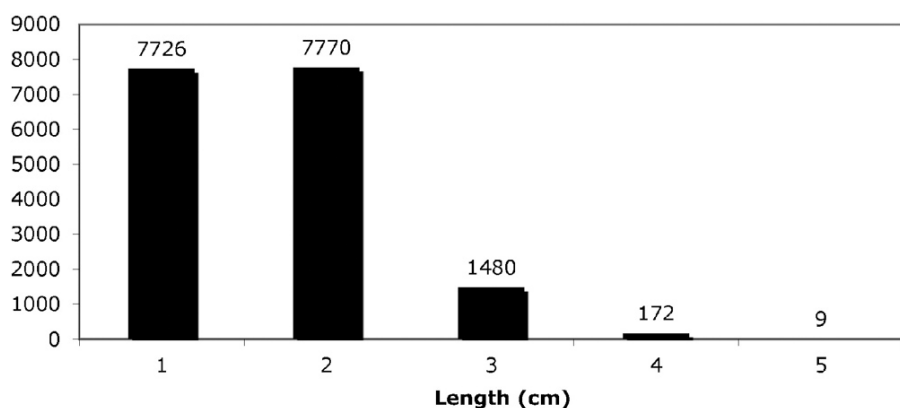


Fig. 5.6. Distribution of digested bones from Çatalhöyük East Mound by length.

Table 5.2. Çatalhöyük East Mound macromammalian identified taxa, undigested and digested

Taxon	Undigested		Digested	
	NISP	%	NISP	%
Sheep/goat	46,976	65	3584	95
Cattle	18,943	26	81	2
Deer	1295	2	12	0
Boar	1438	2	31	1
Equid	1496	2	16	0
Dog	903	1	30	1
Other	894	1	45	1

We have recovered a number of coprolites that clearly derive from a mammalian carnivore in the dog size range and contain pieces of digested bone, although most of the digested bone is no longer contained in coprolites. Human fecal material has recently been identified in one context with digested bone at Çatalhöyük (Shillito *et al.* 2011), but these techniques do not detect carnivore feces, which may also have been present. Some of the digested bone on site likely derives from human coprolites, but much of it is larger than humans would be expected to swallow. Humans would have difficulty swallowing caprine feet, for example. Thus the majority of the Çatalhöyük digested bone is most likely derived from dog feces.

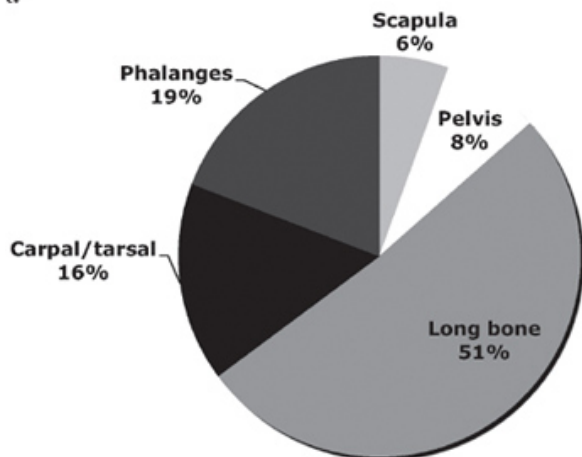
Dogs, too, are not random in the bones they swallow and later excrete: digestion affects taxa and body parts differentially (see Table 5.1). At Çatalhöyük, sheep/goat bones are even more prevalent (95%)

among the identified digested bones than in the general assemblage (Table 5.2). The pattern is similar among the unidentified digested bones, with 92% sheep-size and 6% cattle-size. Or, to look at it from the other way around, 11% of postcranial sheep/goat bones are digested, and 2% of cattle. Cranial bones are rarely digested, so henceforth we will focus on the sheep/goat postcranial bones.

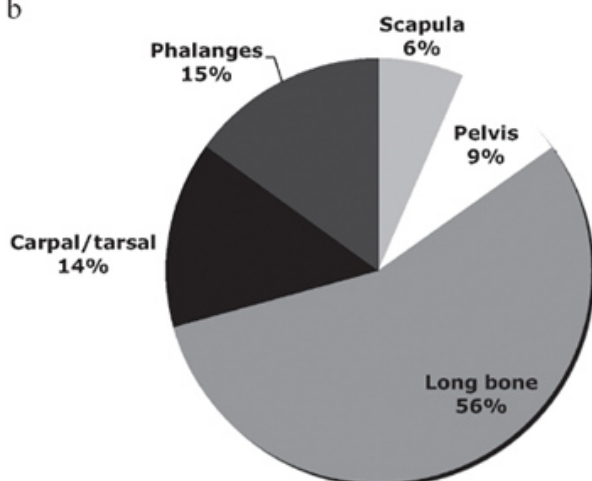
The digested and undigested assemblages will also differ in body part distribution, notably with higher proportions of carpals, tarsals, and phalanges in the digested assemblage (Fig 5.7). These smaller bones are easier to swallow, and more likely to remain identifiable after digestion than similar-size fragments of larger bones. Moreover, people may be more willing to let dogs eat the feet of butchered animals, since they have no meat.

Furthermore, since dogs do not necessarily defecate in the same place that they eat, digested bones are at least in secondary context. Dogs may swallow bones off-site and then deposit them on-site, adding to the assemblage; bones may also come from different (roughly contemporary) contexts within the site. Given these complexities, there is an argument for excluding digested bones from the analysis if one is interested in local behavior. However, if the undigested assemblage was exposed to dogs, it will have suffered disproportionate loss of some body parts, which is partially compensated by the digested bones. It is therefore preferable to explore in each case the effects of attrition and digestion.

a



b



c

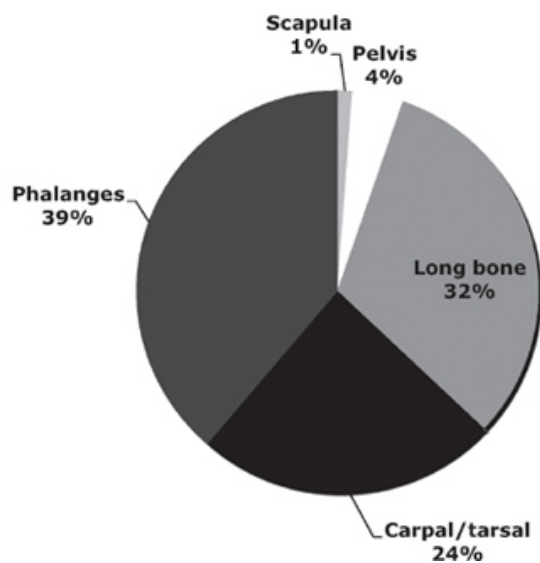


Fig. 5.7. Body part distribution for sheep/goat from Çatalhöyük East Mound: a) all specimens, b) undigested, c) digested. Long bones, carpals/tarsals, and phalanges are grouped for easier presentation, but the digestion rates are similar for individual elements within each category.

This study was motivated by a concern that sheep-size body part distributions might be significantly skewed by the presence of bones derived from dog feces. Digested bones are quite common at the site, forming 7.5% of the East Mound mammalian assemblage, or 9% of the pieces under 4 cm, that is, in the size range dogs typically swallow. We suspect that butchery occurred off-site or on its margins. First, the roof entrances and lack of alleys would likely make on-site butchery difficult, although sheep and goats could have been butchered on roofs or in midden areas after being carried over the roofs. Second, sheep-size vertebrae and rib heads are under-represented on site, and may have been left at butchery locations (Russell & Martin 2005, 90).

There are few long bone cylinders at Çatalhöyük, a classic indication of dog activity (Binford 1981, 173–174), and the incidence of gnaw marks is low, in fact much lower than the incidence of digestion (Russell & Martin 2005, 41). Gnawing tends to occur when dogs are resting or bored. We supposed that dogs infrequently relaxed on site, rather living on its margins and venturing among the houses on brief forays to bolt down whatever they could scavenge. Since we noticed some units where all or nearly all the phalanges, carpals, and tarsals were digested, we hypothesized that, like the vertebrae and rib heads, these were usually discarded at the butchery location, rarely coming on site except in the excretions of dogs that had scavenged in the butchery areas.

Dog activity in context

We explore the effects of dog defecation on body part distributions contextually through the examination of a series of midden deposits from varying temporal and spatial locations at Çatalhöyük. We focus on midden deposits because they contain large amounts of bone accumulated over relatively short lengths of time. Most animal waste, with the likely exception of primary butchery waste, seems to have been dumped in middens in the first instance, so they provide the best overview of meat consumption. Other kinds of deposits are either special selections of material (e.g., Russell *et al.* 2009), or redeposited material, often derived in part from other middens of unknown date, used as construction material or fill. Within each space, we compare

midden assemblages that have suffered differing levels of modification by carnivores as attested by the presence of gnaw marks and especially the degree of density-mediated attrition exhibited in the body part distributions. In the more heavily affected assemblages, dogs have removed substantial amounts of bone through gnawing and swallowing, some of which would be expected to survive in their feces. We selected the middens to represent three major temporal divisions at the site (Russell *et al.* 2013) in order to explore potential changes in the treatment of dogs and their access to meat and bones. We also explore possible spatial variation between the northern and southern lobes of the tell.

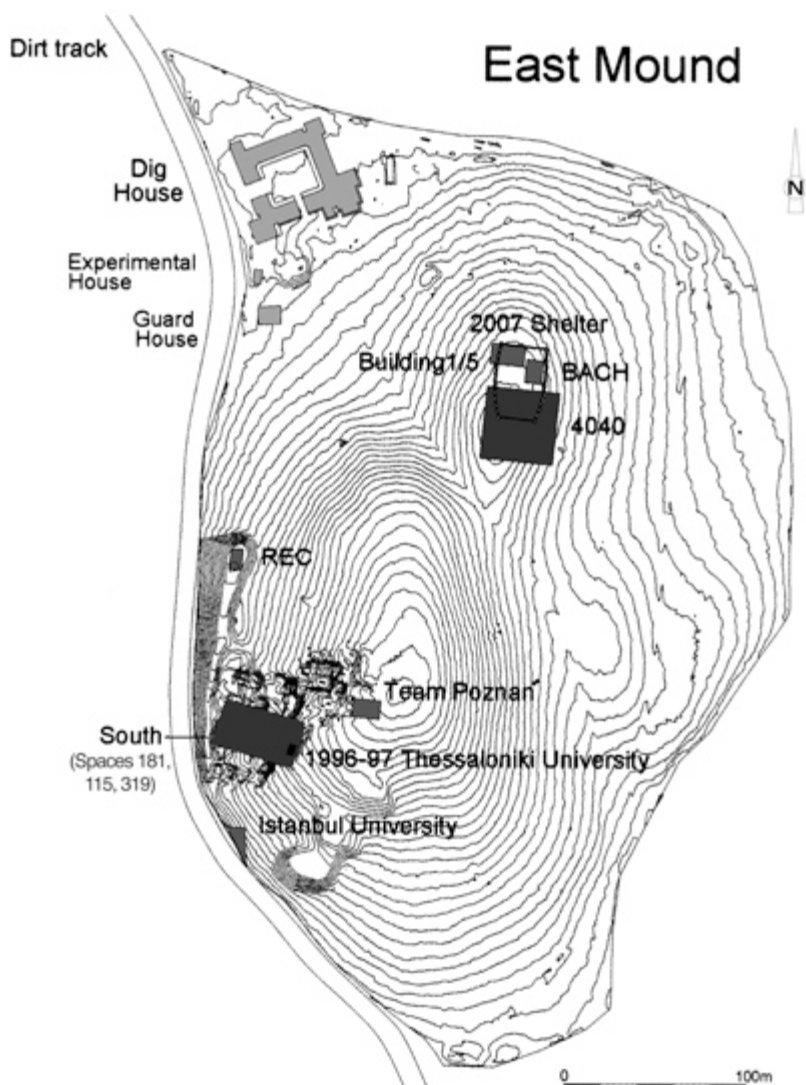


Fig. 5.8. Çatalhöyük East Mound plan, showing excavation areas and

Space 181

Space 181 was located in the deep sounding at Çatalhöyük (Fig. 5.8) and comprises the earliest on-site deposits so far excavated (pre-XII in Mellaart's scheme; South.G in the new phasing). In fact, there is no architecture in this part of the sounding, and we believe that this area was actually a zone of dumps on the edge of the early, smaller settlement. Most of the bone derives from heavily processed remains of daily consumption. This sort of site-edge location is precisely where we might expect butchery to occur. It is also clear that dogs spent considerable time here. To a much greater extent than truly on-site deposits, these assemblages have been worked over by dogs, showing substantial attrition, although to varying degrees.

Here we compare the more heavily and the only moderately worked over layers from Space 181, as assessed by the degree of density-mediated attrition and incidence of gnawing (Table 5.3). In both cases, carpals, tarsals, and phalanges are substantially more frequent in the digested than the undigested assemblages (Fig. 5.9). Interestingly, they are also less frequent in both digested and undigested assemblages from units that have been more thoroughly worked over by dogs. Dogs will presumably swallow more attractive items first. In dump areas such as Space 181, caprine and other feet may be the only part that regularly retains soft tissue (skin and tendons), whereas other body parts are dumped post-consumption with meat removed. After swallowing the feet, if dogs have the opportunity to spend more time in the dump (or lack better opportunities elsewhere), then they will turn to gnawing and swallowing other bones. The result is that in thoroughly worked over assemblages, the dogs have both removed high proportions of the phalanges from the undigested portion, and also added proportionally more of other body parts to the digested material.

Table 5.3. Proportion of digested sheep/goat postcranial bone in middens discussed in the text

<i>Midden</i>	<i>Dog activity</i>	<i>Sheep/goat postcranial NISP</i>	<i>Sheep/goat postcranial digested</i>	<i>Sheep/goat postcranial % digested</i>
Space 181	Moderate	1131	138	12
	Heavy	1103	265	24
Space 115	Slight	1126	174	15
Space 319	Slight	985	31	3
	Moderate	2227	487	22
4040 Area	Slight	2523	50	2
	Moderate	2499	662	26

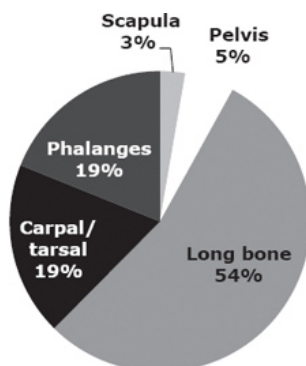
Space 115

Space 115 is a large midden area in the South Area, surrounded by houses and thus clearly on-site (see [Fig. 5.8](#)). It is assigned to Level VIII in Mellaart's stratigraphic scheme, or roughly South.L in the new phasing. All of the midden units we have recorded from this area appear to have been relatively protected from dogs. While there are certainly indications of canine activity, the material is only lightly worked over (see [Table 5.3](#)). Here we see lower numbers of carpals/tarsals and especially phalanges among the digested bones than are found in Space 181, but still higher than in the undigested assemblage ([Fig. 5.10](#)). Despite the fact that dog activity is low, the proportions of carpals/tarsals and phalanges in the undigested assemblage are similar to the heavily worked-over units in Space 181. Thus some sheep/goat feet were clearly brought on site, although they were probably often left off-site as butchery waste.

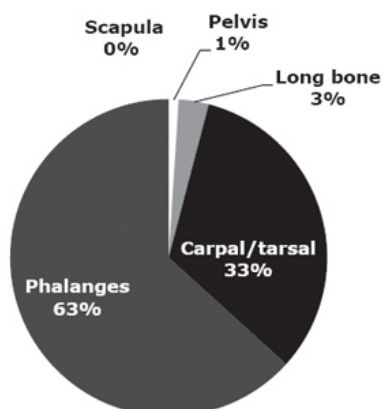
Space 319

Space 319 is an on-site midden area higher in the South Area sequence (see [Fig. 5.8](#)), associated with the occupation of Building 44, now believed to belong to Mellaart's Level II or South.S. Most of the units we have studied were moderately worked by dogs, while one (16253) was only slightly worked over (see [Table 5.3](#)). As usual, the digested assemblages have higher proportions of foot bones (carpals, tarsals, and phalanges) than the undigested ([Fig. 5.11](#)). As in Space 181, this is especially true in the less-worked-over unit. Once again, substantial numbers of undigested sheep/goat feet are present on site.

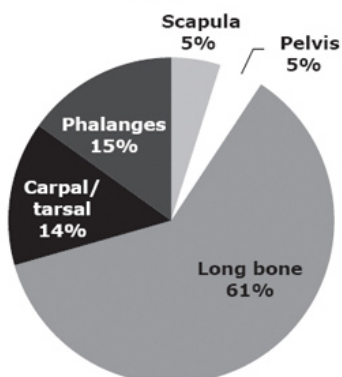
a



b



c



d

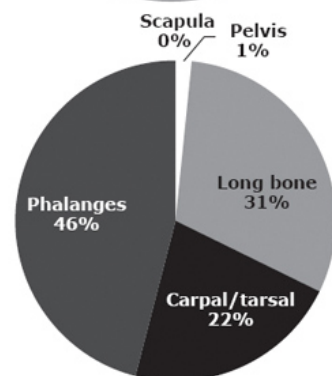


Fig. 5.9. Sheep/goat body part distribution from Space 181: a) undigested bones from moderately worked over units, b) digested bones from moderately worked over units, c) undigested bones from heavily worked over units, d) digested bones from heavily worked over units.

4040 Area

The 4040 Area is located on the northern lobe of the East Mound (see [Fig. 5.8](#)). Several midden areas have been excavated there between the houses. It is difficult to place them chronologically with precision at this time, since the area is not contiguous with that excavated by Mellaart; they are probably roughly equivalent to Levels VI–I for Mellaart or South.N-T.

Most of these middens were very rapidly buried and exhibit remarkably fresh surfaces, with limited exposure to dogs. A few were moderately worked over by dogs, and may have accumulated somewhat more slowly (see [Table 5.3](#)). As elsewhere, foot bones are proportionately better represented in the digested than the undigested assemblages, although in contrast to Space 181, they are modestly more common in the assemblages that have been worked over more ([Fig. 5.12](#)). However, here we are comparing light vs. moderate dog activity, as opposed to moderate vs. heavy activity in Space 181. There is little difference between the undigested portions of the lightly and moderately-worked-over assemblages, both of which have significant numbers of foot bones.

Summary

Our examination of these four midden areas has shown that the proportion of sheep/goat foot bones (carpals, tarsals, and phalanges) is always higher in the digested than the undigested assemblages, confirming that dogs are particularly prone to swallow these parts, and that they are dense enough to survive the canine digestive system with some frequency.

However, our initial hypothesis that dogs were moving sheep/goat foot bones onto the site from its margins does not hold up. The substantial number of undigested foot bones shows that feet were not routinely left at off-site butchery areas. Since the other evidence for off-site (or site margins) butchery still applies, Çatalhöyük's Neolithic inhabitants were probably bringing many of the feet into the settlement. They may have come in attached to hides, to be discarded in later processing. Also, concentrations of sheep/goat metapodials

with phalanges and/or carpals and tarsals still attached have been found in a few houses, and are probably caches of raw material for making the ubiquitous bone points (Russell & Griffiths 2013; Russell *et al.* 2013; Twiss *et al.* 2008). Again, if metapodials were collected for tool use with the smaller foot bones attached, these smaller bones were presumably discarded in middens near the houses during later preparation of the metapodials for working.

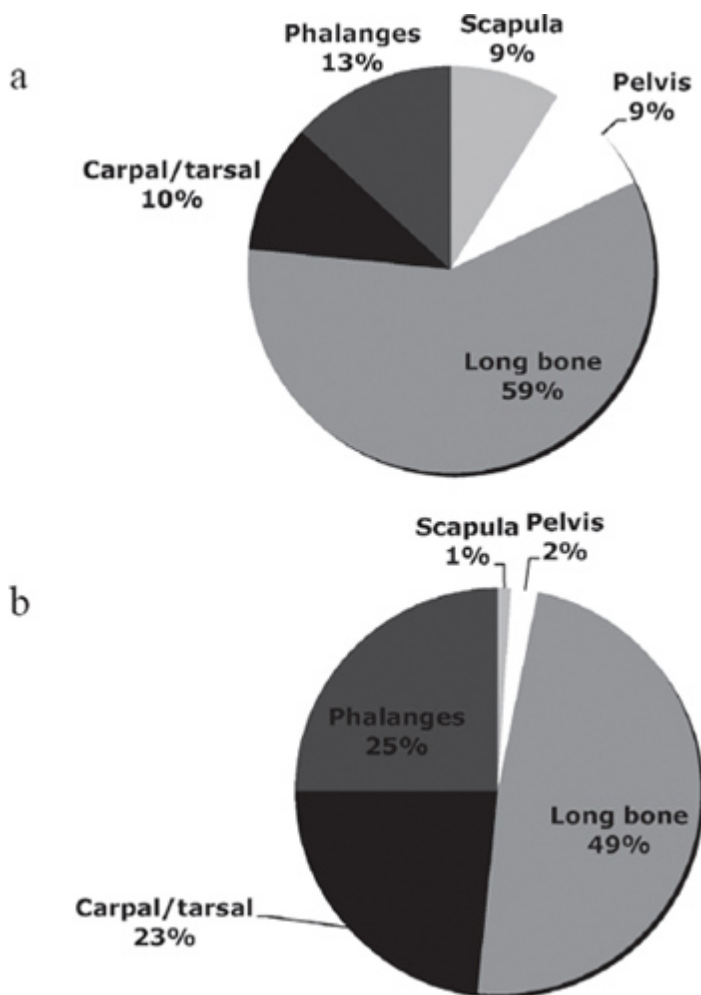


Fig. 5.10. Sheep/goat body part distribution from Space 115: a) undigested bones, b) digested bones.

We also note that while the proportion of carpals/ tarsals and phalanges is always elevated in the digested assemblages, the variation in frequency generally tracks that in the undigested assemblages. This indicates that the digested foot bones on site are not primarily derived from feet eaten on the site margins by dogs darting

in briefly to scavenge on site. Rather, dogs apparently lived, or spent substantial time, in both locations, excreting in the same general area that they scavenged.

Human–dog relations

Ethnographically it is clear that there is a wide range of human–dog relations. Dogs may be treasured pets, and not only in modern western societies (e.g., MacKinnon & Belanger 2006; Ojoade 1990; Trantalidou 2006); they may be highly valued for their assistance in hunting or herding (Bulmer 1976; Ojoade 1990; Willerslev 2007); or their watchdog and scavenging functions may make them worth having whether they are treated with great affection or not (Butler 1998; Ekvall 1963; Willerslev 2007). In some cases they are raised for food (Wing 1978), or (more often) eaten occasionally, in times of famine or for specific ritual or medicinal purposes (Ojoade 1990; Trigger 1990). Dogs may be confined to the immediate area of their houses, or owned by individuals but free-roaming, or feral pariahs owned by no one and lurking on the edges of human settlements (Butler *et al.* 2004; Ekvall 1963; Manwell & Baker 1984; Meggitt 1965; Oppenheimer & Oppenheimer 1975).

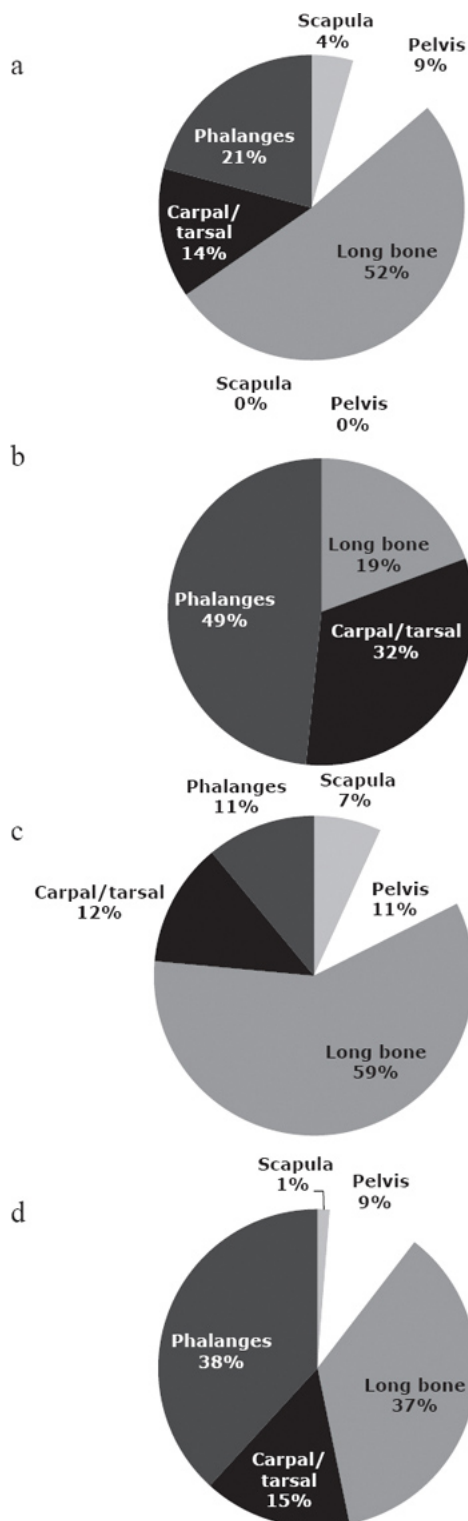
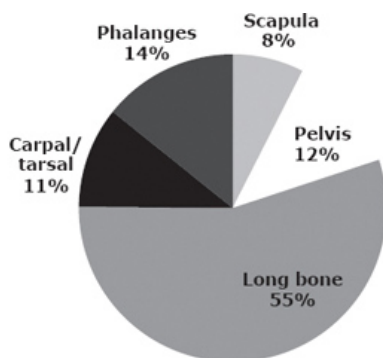


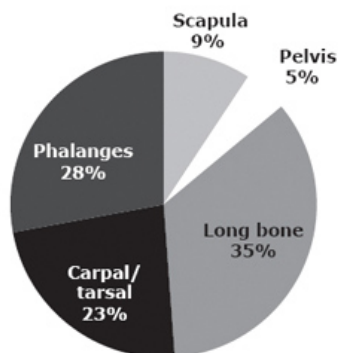
Fig. 5.11. Sheep/goat body part distribution from Space 319: a) undigested

bones from slightly worked over units, b) digested bones from slightly worked over units, c) undigested bones from moderately worked over units, d) digested bones from moderately worked over units.

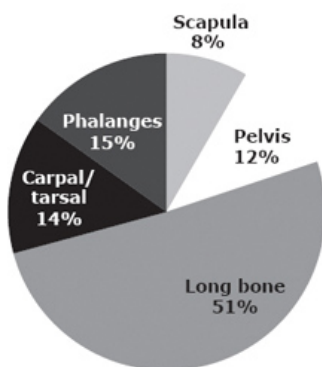
a



b



c



d

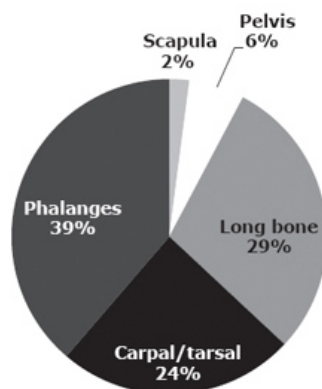


Fig. 5.12. Sheep/goat body part distribution from the 4040 Area: a) undigested bones from slightly worked over units, b) digested bones from slightly worked over units, c) undigested bones from moderately worked over units, d) digested bones from moderately worked over units.

At Çatalhöyük, the distribution of gnawed and digested bone indicates that dogs lived both on the edge of the site and in midden areas among the houses. Gnawed bones are lacking in the sweepings deposits that are most closely associated with occupation inside houses, suggesting that dogs were not allowed in houses during occupation (Russell & Martin 2005, 41–42). Gnawed and digested bones are also virtually absent from penning deposits where sheep and goats are believed to have been kept on site, so dogs were probably banned from these areas as well.

There is no indication that Çatalhöyük's dogs were regarded as pets. There are no dog burials, although there are complete dog skeletons that have been disposed of in middens or abandoned houses; no dogs are buried with humans or in the manner of humans, below house floors. Dogs were certainly not raised for food and were not normally eaten, but butcher marks on a few dog bones indicate that they were occasionally consumed.

Dogs seem to have limited ritual salience at Çatalhöyük. While animals proliferate in the art, dogs are rarely or never depicted. One painting in building F.V.1 clearly shows a canid (Mellaart 1966, pl LXIa), although it could as easily be a wolf or a fox as a dog. Mellaart (1966; 1967) refers to a few other figures in paintings as dogs, but we would prefer to call them quadrupeds. Dog remains are rare in special deposits and are never installed in architecture as are cattle horns in benches, or boar jaws in walls, for example (Russell & Meece 2006).

Anyone who spends time around dogs will observe that they eat their own and other feces, as well as other things most people find disgusting, such as rotting flesh. This habit engenders varying reactions in people. For some, it makes dogs unclean (e.g., Willerslev 2007). On the other hand, Zoroastrians venerate dogs because they cleanse the world of impurity (Boyce 1993). Some argue that dogs were not deliberately domesticated for hunting, but rather speciated on their own as wolves moved into a scavenging niche around human settlements, and the hygienic effect of their scavenging was appreciated (Montagu 1942; Coppinger & Coppinger 2001).

In rural Zimbabwe human feces constitute over 20% of dogs' diets by volume (Butler 1998; Butler & du Toit 2002). In West Bengal, pariah dogs eat garbage, carrion, and human feces. Oppenheimer and

Oppenheimer (1975, 87) consider these feral dogs ‘the most important component of the natural waste disposal system’ around human settlements. They even suggest that the dissemination of human viruses in dog feces (a result of the dog’s consumption of human feces) provides a low-level exposure that boosts human immunity, a sort of natural vaccine. Similarly, Sharp (1976) observes that loose dogs devour anything they can find in Chipewyan settlements, reducing all organic waste to human and dog excrement. In fact, the dogs also convert much of the human excrement to dog feces, as they scavenge the excrement of children too young to use the latrines as well as digging into the latrines themselves. He suggests that:

[t]his processing by dogs must reduce the number and type of bacteria, especially in the warm months. As the Chipewyan are casual in their disposal of trash and garbage, it is doubtful that the village would be habitable without at least some loose dogs on the prowl at all times. (Sharp 1976, 28)

The same is true for the dogs of the Jankuntjara in Australia’s Western Desert, where one study suggests that human pathogens do not survive in dog feces (Hamilton 1972). In Nigeria, infants are often left with dogs, who eat the child’s excrement and lick its anus clean (Ojoade 1990, 216).

Conditions at Çatalhöyük would have been similar, and the large, densely-packed settlement would have generated a lot of waste. Dogs may well have been valued, or at least tolerated, for their reduction of smelly waste through their scavenging, as well as their guard function. They may also have been used in hunting, since wild game is consumed throughout the occupation (Russell *et al.* 2013).

Attitudes to carnivore feces

Dog feces are generally considered dirty and disgusting: applying them to someone or their house or possessions is a readily understood insult. In Malawi, for instance, carrying dog feces in a broken pot on one’s head is a humiliating punishment (Morris 2000, 107). Çatalhöyük’s residents were clearly concerned about dog feces, since they sometimes gathered them into impressive concentrations. For example, Building 2 in the South Area has multiple layers with high concentrations of digested bone (up to 45%) in the fill of a side room.

We are not sure why the Neolithic inhabitants of Çatalhöyük gathered and dumped or stored dog feces. It may have been to clean up, removing dog feces from troublesome locations. Certainly not all dog feces were collected, however; as we have seen, they occur in reasonable quantities in midden areas. Possibly the feces were stored for use. Dog feces were used for tanning in Roman and medieval

Europe (e.g., Smith 2006, 14), and might have been at Çatalhöyük as well. However, tanning, which is inherently smelly no matter what is used, seems like a better activity for the margins of the site than the centre. We find enough digested bone in building material to raise the possibility that dog excrement was deliberately added to the mixture, although perhaps only after it was well composted.

Not only dog excreta were collected. The evidence for burning ruminant dung is hardly surprising, but we also find collections of small carnivore feces at Çatalhöyük. Two burials have concentrations of microfauna with tooth marks of a small carnivore (ca. wild cat or polecat size) and traces of digestion: small carnivore feces (Jenkins 2005, 112–114). An additional burial excavated by Mellaart contained a similar concentration (Mellaart 1966, 182). Cats and mustelids do not defecate in their lairs, so these must be deliberately placed. None of these burials show signs of other unusual treatment to indicate that this was meant as an insult or curse. Indeed, they contain other grave goods and Mellaart considered the one he excavated to be of relatively high status. The same side room of Building 2 with the dog feces concentrations also has a layer of digested microfauna (mostly house mouse) in remarkable quantities, apparently also a collection of small carnivore feces (Jenkins 2005, 114). These feces presumably derive from a wild animal, so were likely collected elsewhere and brought on site. Conceivably carnivore feces had medicinal or other power.

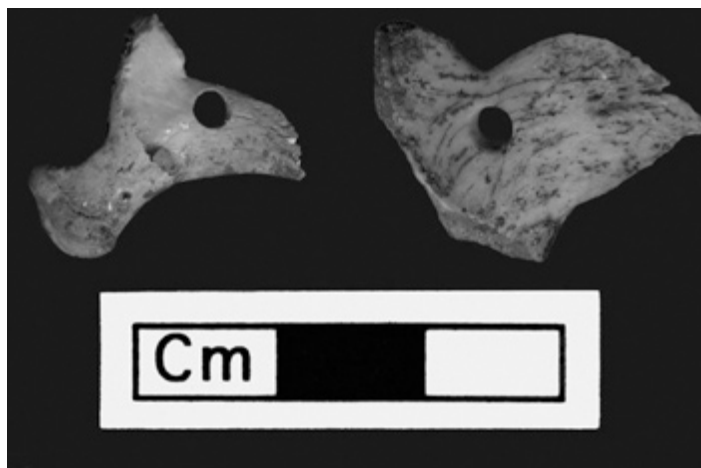


Fig. 5.13. Pendants on a genuine leopard claw (left, 11306. X2) and a chip of digested bone (right, 10818.X1).

Digested bones that most likely derive from dog feces were sometimes collected and used by the Çatalhöyük inhabitants. Digested astragali were modified and used as knucklebones for gambling,

divination, or play (Russell and Griffiths 2013). A chip of digested large mammal long bone that resembles a leopard claw was perforated as a pendant, presumably evoking a real leopard claw (Fig. 5.13). These practices might mean that dog feces were not considered utterly repulsive. However, at a site occupied for as long as Çatalhöyük, people may have collected the digested bones after the feces had decomposed, and may or may not have recognised them as digested.

Conclusion

Methodologically, we wish to point out that the mobility of dogs and their ability to forage for themselves means that digested bone derived from dog feces is potentially not from the same place as the undigested bone. At Çatalhöyük, there does not in fact seem to have been a great deal of displacement (implying relatively limited dog mobility), but this will not always be the case. Thus, it is worthwhile looking at the digested and undigested assemblages separately.

Apart from potential taphonomic bias, the distribution of dog-altered bones, both gnawed and digested, informs us about dogs' access to various spaces and thus about human attitudes to dogs. The co-variation of proportions of small foot bones in digested and undigested assemblages across the site indicates both that feet were brought onto the site in undigested form and that dogs tended to spend much of their time in relatively small areas. They do not seem to have lived in the houses, but had territories in the open midden areas nearby. While not definitive evidence, this raises the possibility that dogs were owned by (or attached to) individual families rather than forming a pack of semi-wild pariah dogs on the outskirts of the settlement. In addition to processing waste, such dogs may have performed an important guard function for their owners, perhaps particularly useful for people inside windowless houses with roof entrances.

While the evidence suggests that dogs were tolerated more than loved at Çatalhöyük, their scavenging function, as well as their watchdog role, may have been valued on this densely packed site. The undigested material in the middens, most of which are not heavily worked over by dogs, shows that there were not enough dogs to keep up with the amount of waste generated by the site's inhabitants. Nevertheless, they probably reduced the amount of smelly garbage to a much smaller and slightly safer quantity of smelly dog feces. In the future, it would be useful to analyze the dog coprolites to learn more about the composition of their diet. Maldre's (2006) study of Bronze Age dog coprolites from Estonia shows that dog diet generally

mirrored that of humans, but for some reason they did not consume seal bones. With modern dog feces it is possible to identify whether they have consumed human excrement (Butler 1998); if this were possible from coprolites it would establish whether recycling human feces was one of the Çatalhöyük dogs' contributions.

At Çatalhöyük, people collected some, but not all, of the dog feces, as well as that of smaller carnivores. At this point we cannot be certain whether this is because the excrement was bothersome or useful. The deposition of small carnivore scat in graves with no apparent intention of disrespect suggests appreciation of at least some carnivore excreta, arguably supporting the idea that people at Çatalhöyük may not have gathered dog feces because of a concern with purity or cleanliness. Moreover, some bone points were gnawed by dogs either prior to manufacture or during their use lives and continued in use, showing that dogs cannot have been seen as utterly polluting.

Perhaps excreta were seen as part of a cycle of lifegiving materials. At any rate, at least some carnivore feces seem to have held some kind of value. Further study of digested bones should clarify the role and import of feces – and of their canine producers – at Çatalhöyük, and shed additional light on Neolithic society, hygiene, and ideology. However, even this small study proves that digested bones are a valuable source of information. We encourage all zooarchaeologists to view them not just as evidence of attrition but also as reflections of ancient human as well as animal behavior.

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We thank all our colleagues in the zooarchaeology lab at Çatalhöyük who helped record the digested and undigested bones through the years, and with whom we have had countless conversations that have stimulated our thinking about these bones. We are also grateful for Philippe Fosse's thoughtful comments on an earlier draft, which have considerably improved the paper.

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Part 2

Caucasian zooarchaeology

6. Carnivora mammals of the Holocene in Armenia

Nina Manaseryan

This paper deals with the occurrence of terrestrial wild carnivores in Armenia during the Holocene. Faunal lists from 80 sites have been analysed. The available data demonstrates the presence of 14 carnivore species.

Keywords Holocene, Armenia, carnivores, species composition.

Introduction

The present study was initiated by my former colleague, the well-known archaeozoologist S. Mejlumyan. In 1988, she started to collect data concerning subfossil finds of mammal species in Armenia by analysing faunal compositions from archaeological sites. Due to Dr Mejlumyan's untimely death in 1993, this study remained unfinished. This paper aims to reinstate Dr Mejlumyan's research on Holocene carnivores in Armenia. Since then much work has been done, mainly in completing the database for all respective species (Manaseryan & Ghasabyan 1998; Manaseryan & Mirzoyan 2005). This contribution presents the first summary about the history of carnivores during the Holocene in Armenia.

Mammals, including the largest terrestrial predators, are rather diverse in their size, external shape and way of living. They are adapted to the acquisition and eating of mainly vertebrates, both on land and in water. The enlarged canines and existence of predatory teeth in the upper and lower jaws are a marked characteristic of carnivores. Identification of predators present on archaeological sites based on their bone remains is not difficult as such. The skull and cheek teeth possess many diagnostic and distinguishing features.

Nineteenth century researchers noted the remains of brown bear, weasel, badger and marten during the excavations of caves, small caverns and karst systems.

The oldest bone remains of carnivore mammals in Armenia are found from the Mousterian period, from sites such as Yerevan and Lusakert Cave. Analysis of bone remains from the above mentioned sites identified seven species belonging to the families of Canidae, Ursidae, Mustelidae and Felidae (Mejlumyan & Manaseryan 1973).

During the Holocene, the diversity of species at archaeological sites which have been investigated is much greater. The study of faunal remains from Holocene sites in Armenia has identified 14 species of mammalian predators. These include members of the Canidae (wolf, jackal and fox), Ursidae (bear), Mustelidae (marten, marbled polecat, weasel, badger and otter) and Felidae (leopard, steppe cat, forest cat and jungle cat) family (Manaseryan & Ghasabyan 1998).

This review of Holocene carnivores from Armenia (Fig. 6.1) is based upon material from scientific collections and archaeological excavations carried out with the participation of the author. The material belongs to various time-periods and different geographic zones, including sites from plains, sub-mountainous and mountainous regions (Appendix 6.1).

Description of species

Family Canidae

Three canid species are represented in the Holocene fauna of Armenia:

Fox: *Vulpes vulpes* (Linnaeus 1758)

The majority of the material consists of skulls, mandibles and postcranial skeletal remains from the following sites: Khatunarkh (5th–4th millennium BC), Mokhrablur (4th– 3rd millennium BC), Shengavit (4th–3rd millennium BC), Shirakavan (4th–1st millennium BC), Artik (Late Bronze Age), Lchashen (2nd–1st millennium BC), Lori Berd (Middle Bronze–Early Iron Age), Talin (4th–3rd centuries BC), Karashamb (2nd millennium BC), Argishtihinili (Urartu), Karmir blur (Urartu), Horom (1st millennium BC), Beniamin (6th century BC–4th century AD). This species is a typical resident of lowland steppe and semideserts. Interestingly, the fox bones are almost always well preserved, which is indicative they were not consumed. However this little animal possesses a beautiful fur appreciated for its value. It is a game species and a target for sports hunting. Today it is a common

member of the Armenian fauna. It inhabits various landscape zones, ranging from subtropical and semi-desert zones to forest and Alpine meadows.

Jackal: *Canis aureus* (Linnaeus 1758)

Jackal remains were first recorded in Armenia at the Palaeolithic caves of Yerevan 1 and Lusakert. Its remains are rare at Holocene archaeological sites. Some postcranial bones have been discovered from the Sevan region, from Karashamb (2nd millennium BC), Dvin (Medieval city) and Artashat (1st century BC–1st century AD). It is not a widespread animal in Armenia, and it occurs only in reed beds and shrubby valleys of the Arax River.

Wolf: *Canis lupus* (Linnaeus 1758)

Wolf, like jackal, has been recorded at the Palaeolithic cave of Yerevan 1. Its remains are not numerous at Holocene archaeological sites. A skull and some post-cranial bones were found at the Yeghegis settlement. It should be noted however that bone fragments from large dogs are not always easy to differentiate from those of wolf bones. The same conclusion can be drawn if one considers skull measurements ([Table 6.1](#), and [Appendix 6.2B](#)).

Family *Ursidae*

Bears are large sized animals with strong and powerful bodies.

Brown bear : *Ursus arctos* (Linnaeus 1758)

Subfossil remains of brown bears include skulls and upper jaw fragments from the following sites: Khatunarkh (5th–4th millennium BC), Karashamb (2nd millennium BC), Tsamakaberd (2nd millennium BC), Sevan fortress (3rd–2nd millennium BC) and Yeghegis cave. It is a game species which is the target of sports hunting. Its gallbladder is of high medicinal value:

‘If you mix bear gall with honey and pepper, then grind and apply it onto a bald head, it will help a dense hair growth. You have to apply it six times. And if one drinks gall mixed in honey and vinegar, it will heal liver disease. Bear gall is like bull’s gall [[Fig. 6.2](#)]. If you mix it with honey and have an epilepsy sick person to drink and lick it a bit, it will help tremendously. If you mix bear gall with a fresh fennel juice and drip into the eye, it will improve your eyesight’. (Amirdovlat Amasiatsi, XV c).

The brown bear is the largest species occurring in Armenia from the post glacial period right up until the present day. It is included in the USSR and Armenian SSR Red Data Books. Individual skull measurements of extant *Ursus arctos* from Armenia are listed in

Family Mustelidae

The mustelids are a biologically diverse group of small to middle sized predators.

Otter: *Lutra lutra* (Linnaeus 1758)

Otter bones are rarely found and are not abundant in the monuments of Armenia. It is represented in low numbers in the excavated specimens.

Skull fragments were discovered in the Lchashen burials (2nd–1st millennium BC), as well as on the shorelines of Lake Sevan (2nd millennium BC), near Akhkala village. Its meat was not used for food, although it was a valuable fur animal. At present they occur in rivers and lakes from the dry subtropics and semi-desert habitats up to forest and mountainous steppes. It is included in the USSR and Armenian SSR Red Data Books. Individual skull measurements of extant *Lutra lutra* from Armenia are listed in [Appendix 6.2D](#).

Badger: *Meles meles* (Linnaeus 1758)

Subfossil badger bones are represented by skulls, mandible and postcranial skeletal elements. They have been discovered at the following sites: Shengavit (4th–3rd millennium BC), Shirakavan (3rd–1st millennium BC), Artik (Late Bronze Age), Lchashen (2nd–1st millennium BC), Lori Berd (Middle Bronze–Early Iron Age), Tsamakaberd (2nd millennium BC), Karashamb (2nd millennium BC), Shamiram (2nd–1st millennium BC), Katnakhpyur (2nd millennium BC), Horom (1st millennium BC), Hoghnik (Hellenistic period), Artashat (1st century BC–1st century AD) and Beniamin (6th century BC–4th century AD) (Manaseryan & Mirzoyan 2005). At present, the badger is distributed in dry subtropics, semi-deserts, mountain steppes, meadow steppes, and forests of the south Caucasus and north Iran. Similar to ancient times, nowadays it is also hunted, perhaps for its fur, fat (used in traditional medicine) and partially for its meat. Individual skull measurements of extant *Meles meles* from Armenia are listed in [Appendix 2E](#).

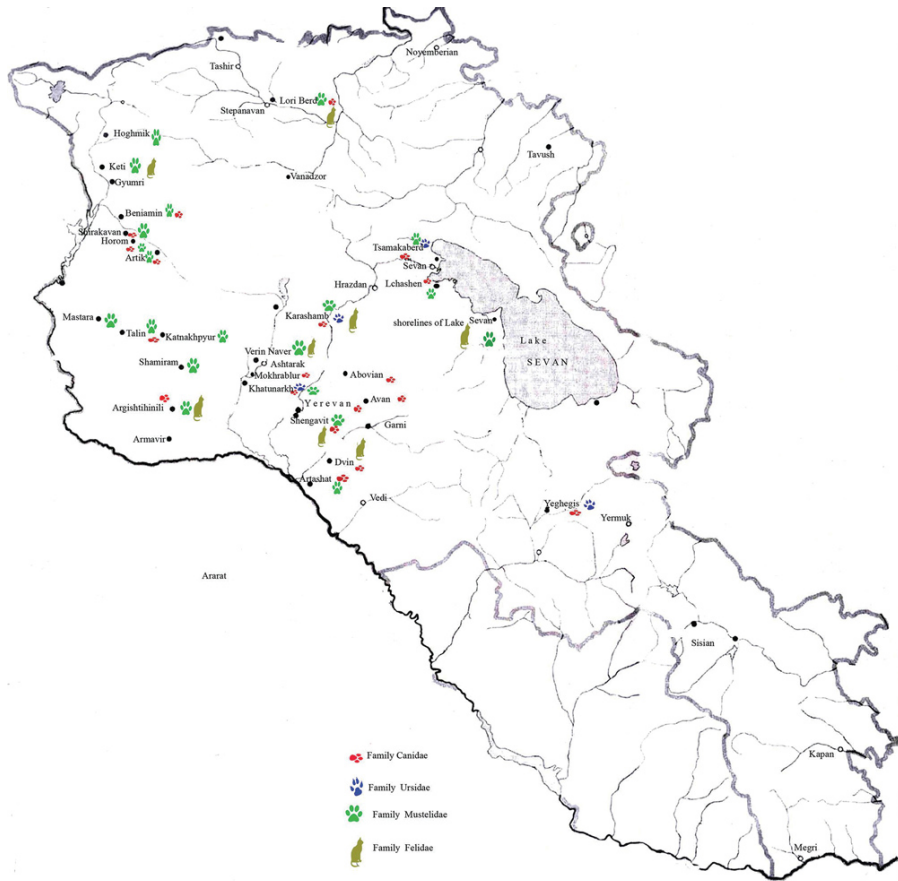


Fig. 6.1. Map of the archaeological sites in Armenia where canid, felid, mustelid and ursid remains have been found.

Table 6.1. Mean measurements of extant wolf skulls

Wolf: *Canis lupus* L. ♂ Skull (n = 10)

Measurement	Min	Max	X
Total length	236	261	247.60
Facial length	136	151	140.80
Palatal length	112	120	115.90
Upper neurocranium length	112	126	118.70
Basal length	205	220	214.00
Zygomatic breadth	129	144	138.44
Condylbasal length	217	236	227.00

Wolf: *Canis lupus* L. ♀ Skull (n = 2)

Measurement	Min	Max
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Total length	233	237
Facial length	134	135
Palatal length	111	112
Neurocranium breadth	60	61
Basal length,	203	203
Zygomatic breadth	120	128
Condylobasal length	215	215



Fig. 6.2. Caucasian Bear gallbladders. These were used in traditional medicine.



Fig. 6.3. Hunting scene with cheetah (after Oughtasar, fig. 7). Rock carvings showing cheetah paws (4th–1st millennium BC).

Marten: *Martes foina* (Erxleben 1777)

Subfossil marten bones include skulls, mandible fragments and postcranial bones. These have been identified from the following sites: Khatunarkh (5th–4th millennium BC), Shengavit (4th–3rd millennium BC), Shirakavan (3rd–1st millennium BC), Talin (4th–3rd centuries BC), Lchashen (2nd–1st millennium BC), Lori Berd (Middle Bronze–Early Iron Age), Sevan fortress (3rd–2nd millennium BC), Artik (Late Bronze Age), Mastara (3rd–1st millennium BC), Karashamb (2nd millennium BC), Horom (1st millennium BC) and Beniamin (6th century BC–4th century AD) (Manaseryan & Mirzoyan 2005). The animal is valued for its fur and liver, used in traditional medicine.

Marbled polecat: *Vormela peregusna* (Güldenstädt 1770)

Excavated subfossil remains are represented by skull fragments and mandibles from the following sites: Shengavit (4th–3rd millennium BC), Ketı (2nd millennium BC), Mastara (3rd–1st millennium BC), Argishtikhinili (Urartu), Sevan fortress (3rd–2nd millennium BC), Shirakavan (3rd–1st millennium BC), Lori Berd (Middle Bronze–Early Iron Age), Artik (Late Bronze Age), Horom (1st millennium BC) and Beniamin (6th century BC–4th century AD) (Manaseryan & Mirzoyan 2005). They mostly consist of single specimens from each location, so it does not appear to have had great economic significance. It is

included in the USSR and Armenian SSR Red Data Books.

Weasel: *Mustela nivalis* (Linnaeus 1766)

Skull and mandible fragments were found at Verin Naver (4th–3rd millennium B.C.) (Mezhlumyan 1988) and Shengavit (4th–3rd millennium BC). The weasel is common throughout Armenia except for in the dry subtropics. Its fur has no economic value.

Family Felidae

The felids are a compact group of morphologically and biologically highly expert middle to large-sized predators.

Felis sp.

Excavated subfossil remains are represented by five skull fragments, found during excavations at the Medieval city of Dvin (Manaseryan 1997), Sevan lake shoreline (2nd millennium BC) and at Ketik (2nd millennium BC). The skull fragments, by their relatively large size and form, suggest that they belong to wild cats.

Within the territory of Armenia, two species of small cats are known to have existed: the steppe cat (*Felis libyca*, Forster) and the forest cat (*Felis silvestris*, Schreber). The relative kinship of both species is obvious however their morphological differences and ecological isolation indicate that they are independent species. Steppe cat (*Felis libyca* Forster) is the assumed predecessor of the domestic cat. The forest cat (*Felis silvestris* Schreber) is listed in the Red Data Book.

Cheetah: *Acinonyx jubatus* (Schreber 1775)

The first evidence for the existence of cheetah from a Holocene site in Armenia was the discovery of a mandible from the settlement at Shengavit (4th–3rd millennium BC). Later, a second specimen was discovered in the ruins of the city of Argishtikhinili (Urartu) (Mezhlumyan 1988).

Leopard and cheetah remains seldom occur in faunal assemblages, however, they are quite commonly depicted in rock carvings. The characteristic morphology of leopards and cheetahs means that it is unlikely to confuse their identification. Leopards generally have rounded paws in the depictions, whilst in the case of cheetahs, their feet are long and strong. This can be seen in [Figure 6.3](#) (after Karakhanian, & Safian P, 1970), where the wide apart paws are depicted with thin lines. This is typical of cheetahs, as they are

amongst the cats which have semi-retractile claws.

Leopard: *Panthera pardus* (Linnaeus 1758)

Leopards inhabit mountainous areas where wild ungulates are also present. It is a rare and endangered species which is protected by Law and is listed in the Red Data Book. Its remains were found near Akhkala village by the shorelines of Lake Sevan (2nd millennium BC).

Lion: *Panthera leo persica* (Meyer 1826)

Actual data on the existence of lions within Armenia were not available until recently. Lion remains have now been identified in the excavated materials from Karashamb (2nd millennium BC) and Verin Naver (4th–3rd millennium BC) (Mezhlumyan, pers. comm.). Published literature also indicates that lions did exist in neighbouring Iran and Turkey, which embraced all the plain and sub-mountainous areas of the East Transcaucasus (Vereshchagin, 1959). Recently, two mandible fragments belonging to different individuals were found in burials of Late Bronze Age to Early Iron Age date at Lori Berd. (Manaseryan 2007).

Of special interest, is a rock carving depicting a lion, discovered in the Gegham mountains. It has a scene illustrating a group of hunters chasing a herd of Bezoar goats that has encountered a lion. Some authors have considered that this image genuinely depicts a real hunting scene from ancient times (Martirosyan 1981).

Despite the limited number of carnivore bone remains from archaeological sites in Armenia, they are of great interest in providing a history of their ancient distribution as well as providing the opportunity to examine their morphological variation.

Valuable outcomes of this present survey include the recording of osteometric data from carnivore skulls ([Appendix 6.2A–E](#)). Analysis of these data suggests that the morphological characteristics of subfossil carnivores have not changed substantially from their recent counterparts.

Conclusion

Summarising the above-mentioned data, it should be noted that the present work is based on the results of studies of over 24,000 bone fragments of vertebrate mammals found from over 80 archaeological excavations dating to various periods.

The following observations can be made:

- Some species are negatively affected by anthropogenic factors, such as wolf, jackal, fox and weasel.
- Some species are affected negatively by anthropogenic factors to a greater extent, such as marten and badger.
- Certain species have strongly declined in their range and quantity, such as bear;
- And finally, some species are critically endangered, such as leopard, steppe and forest cats, otter and marbled polecat.

Carnivores, such as fox, badger, weasel and otter, have since Palaeolithic times provided not only meat, but also fur which was used for making clothes, the pelts being also valuable trade items.

Several of the described species still occur in Armenia at the present day. Four of them are on the verge of extinction: Transcaucasian brown bear (*Ursus arctos*), South-Russian marbled polecat (*Vormela peregusna*), Caucasian otter (*Lutra lutra*) and Leopard (*Panthera pardus*). Cheetah (*Acinonyx jubatus*), and probably Lion (*Panthera leo persica*), have perished since the Medieval period.

It should be noted some parts of their bodies of almost all of the species described above, are used in traditional folk medicine. This has undoubtedly helped to accelerate their extinction.

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Appendix 6.1. List of sites with brief descriptions

Argishtihinili (Urartu) is a large economic, administrative and religious centre in the Ararat valley, situated on the Nor Armavir and Haikavan hills. Excavations were made by A. Martirosyan.

Arin Berd (Erebuni) is a fortress on the left bank of the Ararat valley. It was a large military-administrative centre. Excavations were undertaken here by K. Hovanesyan and F. Ter-Martirosov.

Artashat is a city of the Middle Ages (1st century BC–1st century AD). The excavations are made by B. Arakelyan and Zh. Khachatryan.

Artik is a burial complex situated on the west side of the Aragats mountains. It is dated to the Late Bronze Age. Excavations were made here by the archaeologist T. Khachatryan.

Ayrivan (2nd millennium BC) has natural Holocene burials of bones in the region of the Ayrivan monastery (around the Sevan lake basin).

Beniamin is a site located in the Akhouryan region. It dates from the 6th century BC–4th century AD. Excavations are made by the archaeologist F. Ter-Martirosov.

Dvin is a city of Medieval date. The excavations are made by A. Kalantaryan.

Hoghmik is a temple centre dating to the Hellenistic period, (3rd –1st centuries BC). It is situated in the area of Hamassia region. The excavations are made by archeologist A. Akopyan.

Horom burials are located in the Artik region. They are dated to the 1st millennium BC (9th–8th centuries BC). The excavations are made by the archaeologist R. Badalyan.

Karashamb is located in the Nairi region on the banks of the River Hrazdan. It dates to the 2nd millennium BC. The excavations are made by the archaeologist F. Mouradyan.

Karmir Blur citadel and **Teishebaini City** (Urartu) are located on the left bank of the Hrazdan River (southwest of Yerevan district). The excavations were headed by B. Piotrovskiy.

Katnakhpyur is a necropolis situated in the Talin region. The excavations are made by the archaeologist E. Asatryan.

Keti is located in the Akhuryan region. It has a single settlement phase, dated to the 3rd millennium BC. This is a cyclopic fortress dating to the end of the 2nd millennium BC, with associated burials of the same period. The excavations are made by the archaeologist L. Petrosyan.

Khatunarkh is a site located in the Etchmiadzin region, dating to

between the 5th and the beginning of the 4th millennium BC. The excavations were made by R. Torosyan.

Lchashen are burials close to the villages of Lchashen and Chkalovka. They are situated on drained land some 150–200m distance from the lake shore line. They are dated mainly by the 2nd millennium BC. Part of them is dated to the Early Iron Age (the first half of the 1st millennium BC). Excavations were carried out here by the archaeologists, A. Mnatsakanyan and L. Petrosyan.

Lori Berd are burials situated 3km from Stepanavan city. They date to a period from the Middle Bronze Age– Early Iron Age. The excavations are made by archaeologist S. Devedjyan.

Mastara is located in the Talin region, 2–3km northeast of Mastara village. The burials belong to the Bronze Age more specifically from the middle of the 3rd–1st millennium BC. The excavations were undertaken by A. Israelyan.

Mokhrablur is a multi-period site located in the Etchmiadsin region. It dates to the first quarter of the 4th millennium BC, as well as the first half to mid-3rd millennium BC. Excavations at the site were made by the archaeologist G. Areshyan.

Sevan is a cyclopic fortress located to the southwest of Lake Sevan. It dates to the end of the 3rd and the first half of the 2nd millennium BC. Excavations were made by the archaeologist A. Mnatsakanyan.

Shamiram are burials situated to the northeast of Shamiram village in the Ashtarak region. It is dated to the end of the 2nd and beginning of the 1st millennium BC. The excavations are carried out by the archaeologist G. Areshyan.

Shengavit is a site located to the southwest of Yerevan. It dates to the end of the 4th–3rd millennium BC. The excavations are made by the archaeologist S. Sardaryan.

Shirakavan is situated on the left bank of the Akhouryan River in the Ani region. It dates from the 3rd –1st millennium BC (more specifically to the 9th–8th centuries). Excavations were undertaken here by R. Torosyan, L. Petrosyan, and F. Ter-Martirosov.

Talin is a necropolis in the Talin region. It is dated to the 4th–3rd centuries BC. The excavations are carried out by the archaeologist E. Asatryan.

Tsamakaberd (2nd millennium BC) has natural Holocene accumulation of bones in the village of Tsamakaberd (around the Lake Sevan basin).

Verin Naver is a monument in the Ashtarak region. The burials date here to the end of the 4th and beginning of the 3rd millennium BC. Excavations of the burials was made by the archaeologist A.

Appendix 6.2 Individual skull measurements of some of the extant carnivores from Armenia discussed in this paper

Measurements: 1. Total length; 2. Facial length; 3. Upper neurocranium length; 4. 'Snout' length; 5. Least breadth between the orbits; 6. Neurocranium breadth; 7. Zygomatic breadth; 8. Skull height; 9. Mastoid breadth; 10. Greatest breadth of the occipital condyles; 11. Palatal length; 12. Basal length; 13. Condylbasal length; 14. Greatest palatal breadth; 15. Length of cheektooth row (C1–M2); 16. Greatest inner height of the orbit; 17. Skull height without the sagittal crest.

A. Subfossil skull measurements of Fox (*Vulpes vulpes* L.)

Fox: <i>Vulpes vulpes</i> L. ♂																	
Skull No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
426	141	83	65	59	30	47	70	36	44	25	73	127	133	39	63	24	41
396	149	85	71	60	33	47	80	39	48	25	75	137	144	42	66	25	44
425	136	80	61	55	35	45	72	37	44	24	68	125	131	38	61	25	41
935	–	–	–	50	–	–	–	–	–	–	64	–	–	37	59	23	–
895	141	80	65	59	31	44	–	38	45	25	69	128	135	38	64	23	42
395	132	76	61	54	30	45	66	35	44	23	66	119	124	36	56	25	39
383	142	84	64	59	34	47	–	38	46	25	68	130	135	38	62	24	41
423	140	82	62	61	29	46	71	37	44	23	70	127	132	38	63	24	42
405	140	84	60	60	30	46	69	37	45	25	69	128	133	36	62	24	42
382	146	86	66	60	38	48	80	39	47	27	71	134	138	41	65	26	43
408	143	84	63	61	39	46	–	39	47	27	72	131	137	40	64	25	43
391	–	–	64	–	33	45	73	39	44	25	–	–	–	38	–	25	42
406	147	85	66	64	32	46	73	39	46	24	71	134	140	37	64	21	43
401	142	86	62	63	35	47	75	40	45	23	68	128	134	40	64	24	43
6	134	77	62	56	31	46	68	36	43	23	63	120	126	36	60	24	40
842	139	82	62	59	30	48	73	38	44	24	71	127	131	40	61	26	44
921	140	84	62	61	27	48	–	38	48	25	69	127	132	39	62	27	43
885	137	83	60	62	31	47	70	36	45	24	70	128	138	37	62	24	42
918	146	87	65	64	30	49	72	38	48	25	75	133	139	40	66	25	42
n	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
min	132	76	60	50	27	44	66	35	43	23	63	119	124	36	56	21	39
max	149	87	71	64	39	49	80	40	48	27	75	137	144	42	66	27	44
X	140.8	82.82	63.39	59.28	32.11	46.50	72.29	37.7	45.3	24.5	69.5	128.4	133.8	38.4	62.4	24.4	42.0

Fox: *Vulpes vulpes* L. ♀

Skull No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
402	136.0	78.0	62.0	57.0	31.0	45.0	68.0	38.0	44.0	24.0	66.0	124.0	129.0	38.0	61.0	23.0	42.0
418	131.0	77.0	60.0	53.0	30.0	44.0	63.0	34.0	42.0	22.0	62.0	122.0	125.0	37.0	59.0	23.0	39.0
417	132.0	78.0	57.0	57.0	30.0	44.0	73.0	36.0	43.0	22.0	67.0	122.0	127.0	39.0	59.0	25.0	39.0
429	131.0	75.0	61.0	56.0	27.0	44.0	65.0	36.0	43.0	22.0	65.0	119.0	123.0	36.0	58.0	22.0	40.0
413	131.0	79.0	57.0	59.0	33.0	44.0	69.0	38.0	44.0	25.0	65.0	122.0	127.0	36.0	58.0	24.0	40.0
389	148.0	88.0	64.0	64.0	33.0	47.0	78.0	38.0	45.0	24.0	72.0	133.0	138.0	40.0	64.0	26.0	43.0
416	138.0	80.0	64.0	58.0	28.0	47.0	68.0	37.0	42.0	23.0	67.0	124.0	129.0	38.0	57.0	25.0	41.0
403	149.0	87.0	65.0	65.0	31.0	48.0	71.0	39.0	46.0	25.0	74.0	138.0	142.0	40.0	66.0	25.0	43.0
409	131.0	78.0	58.0	57.0	33.0	45.0	70.0	36.0	43.0	24.0	65.0	118.0	122.0	37.0	59.0	23.0	40.0
387	137.0	82.0	59.0	62.0	33.0	45.0	71.0	41.0	42.0	25.0	68.0	124.0	130.0	36.0	64.0	25.0	39.0
427	130.0	77.0	57.0	56.0	32.0	47.0	70.0	36.0	45.0	23.0	65.0	120.0	125.0	38.0	61.0	24.0	42.0
428	136.0	81.0	61.0	58.0	33.0	46.0	67.0	36.0	44.0	26.0	66.0	123.0	128.0	35.0	60.0	23.0	41.0
414	138.0	80.0	64.0	58.0	32.0	45.0	70.0	34.0	43.0	23.0	67.0	123.0	129.0	38.0	60.0	25.0	38.0
407	140.0	83.0	62.0	60.0	32.0	44.0	71.0	38.0	44.0	24.0	67.0	126.0	131.0	37.0	63.0	25.0	39.0
411	129.0	75.0	60.0	54.0	34.0	44.0	58.0	36.0	41.0	22.0	66.0	119.0	123.0	37.0	60.0	23.0	40.0
775	85.0	61.0	61.0	61.0	36.0	46.0	70.0	38.0	43.0	24.0	70.0	127.0	132.0	34.0	64.0	23.0	41.0
434	139.0	82.0	64.0	61.0	34.0	45.0	-	37.0	44.0	22.0	69.0	126.0	132.0	38.0	-	24.0	40.0
400	134.0	79.0	59.0	58.0	31.0	44.0	71.0	34.0	44.0	25.0	67.0	124.0	129.0	38.0	62.0	26.0	40.0
378	138.0	83.0	61.0	60.0	35.0	45.0	72.0	37.0	44.0	23.0	66.0	123.0	128.0	39.0	61.0	25.0	49.0
919	143.0	84.0	63.0	63.0	33.0	45.0	69.0	38.0	46.0	24.0	74.0	132.0	136.0	38.0	66.0	24.0	40.0
412	131.0	80.0	57.0	58.0	32.0	45.0	70.0	32.0	43.0	24.0	66.0	121.0	128.0	36.0	59.0	25.0	40.0
771	131.0	78.0	59.0	57.0	29.0	47.0	68.0	34.0	44.0	23.0	63.0	121.0	127.0	35.0	58.0	23.0	40.0
min	129.0	75.0	57.0	53.0	27.0	40.0	58.0	32.0	41.0	22.0	62.0	118.0	122.0	34.0	57.0	22.0	38.0
max	149.0	88.0	65.0	65.0	46.0	44.0	78.0	41.0	46.0	26.0	74.0	138.0	142.0	40.0	66.0	26.0	43.0
X	136.0	80.4	60.6	58.7	31.9	45.2	69.1	36.5	43.5	23.5	67.1	124.1	129.0	37.2	60.9	24.0	40.2

B. Subfossil skull measurements of Wolf (*Canis lupus* L.)

Wolf: *Canis lupus* L. ♂

Skull No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
896	238.0	138.0	112.0	107.0	57.0	63.0	129.0	70.0	79.0	47.0	112.0	210.0	224.0	76.0	100.0	38.0	60.0
15	251.0	141.0	121.0	106.0	71.0	62.0	142.0	87.0	79.0	47.0	120.0	218.0	233.0	83.0	101.0	38.0	59.0
371	248.0	138.0	121.0	104.0	67.0	64.0	138.0	76.0	77.0	45.0	114.0	212.0	226.0	77.0	103.0	39.0	61.0
682	261.0	147.0	126.0	112.0	66.0	62.0	144.0	80.0	83.0	49.0	120.0	220.0	234.0	81.0	106.0	41.0	64.0
683	242.0	137.0	115.0	101.0	65.0	63.0	142.0	78.0	79.0	47.0	115.0	212.0	223.0	78.0	101.0	39.0	61.0
923	251.0	141.0	122.0	105.0	62.0	60.0	140.0	72.0	76.0	44.0	120.0	217.0	228.0	81.0	101.0	40.0	56.0
924	247.0	139.0	119.0	105.0	63.0	62.0	136.0	77.0	76.0	46.0	114.0	217.0	229.0	75.0	101.0	39.0	65.0
792	256.0	151.0	120.0	110.0	68.0	60.0	140.0	77.0	80.0	46.0	118.0	220.0	236.0	82.0	105.0	40.0	62.0
13	246.0	140.0	119.0	103.0	71.0	61.0	-	72.0	77.0	43.0	112.0	209.0	220.0	-	99.0	36.0	61.0
17	236.0	136.0	112.0	98.0	68.0	60.0	135.0	73.0	76.0	43.0	114.0	205.0	217.0	76.0	101.0	36.0	64.0
n	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
min	236.0	136.0	112.0	98.0	57.0	60.0	129.0	70.0	76.0	43.0	112.0	205.0	217.0	75.0	99.0	36.0	56.0
max	261.0	151.0	126.0	112.0	71.0	64.0	144.0	87.0	83.0	49.0	120.0	220.0	236.0	83.0	106.0	41.0	65.0
X	247.6	140.8	118.7	105.1	65.8	61.7	138.4	76.2	78.2	45.7	115.9	214.0	227.0	78.8	101.8	38.6	61.3

Wolf: *Canis lupus* L. ♀

Skull no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
672	237	135	114	100	63	60	128	73	75	42	111	203	215	72	96	35	58
895	233	134	110	104	52	61	120	72	74	42	112	203	215	75	96	35	59
n	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
min	233.0	134.0	110.0	100.0	52.0	60.0	120.0	72.0	74.0	42.0	111.0	203.0	215.0	72.0	96.0	35.0	58.0
max	237.0	135.0	114.0	104.0	63.0	61.0	128.0	73.0	75.0	42.0	112.0	203.0	215.0	75.0	96.0	35.0	59.0
X	235.0	134.5	112.0	102.0	57.5	60.5	124.0	72.5	74.5	42.0	111.5	203.0	215.0	73.5	96.0	35.0	58.5

C. Subfossil skull measurements of Bear (*Ursus arctos* L.)

<i>Skull no.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>15</i>	<i>16</i>	<i>17</i>
5	356	179	201	125	97	91	—	107	—	66	167	300	320	85	—	48	80
876	265	135	148	98	80	90	—	83	115	—	131	235	252	75	108	38	73
1	354	172	210	124	111	85	228	111	161	62	162	298	313	78	122	47	83
3	319	178	148	125	112	82	205	—	168	—	174	—	—	85	123	55	—
7	327	162	179	119	95	88	195	106	145	65	166	286	303	80	125	40	79
8	310	148	178	111	90	91	178	95	129	67	—	—	—	76	—	41	76
9	307	155	174	115	87	98	171	88	130	67	153	268	287	75	117	43	68
89	345	179	200	129	117	91	235	—	182	70	169	303	327	83	126	51	78
231	260	135	142	92	70	84	143	78	108	61	126	230	247	77	97	36	63
248	—	—	165	—	92	85	155	87	117	65	—	—	—	82	—	42	76
877	265	137	143	94	79	90	142	—	117	—	135	—	—	77	107	42	—
min	260	135	142	92	70	82	142	78	108	61	126	230	247	75	97	36	63
max	356	179	210	129	117	98	235	111	182	70	174	303	327	85	126	55	83
X	310.8	158.0	171.6	113.2	93.6	88.6	183.5	94.3	137.2	65.3	153.67	274.29	297.71	79.3	115.6	43.9	75.1

D. Subfossil skull measurements of Otter (*Lutra lutra* L.)

<i>Skull No.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>15</i>	<i>16</i>	<i>17</i>
78	114	45	72	32	24	50	67	34	64	30	45	102	111	35	35	17	33
19	124	51	78	38	25	52	74	39	70	34	55	114	124	38	40	19	37
min	114	45	72	32	24	50	67	34	64	30	45	102	111	35	35	17	33
max	124	51	78	38	25	52	74	39	70	34	55	114	124	38	40	19	37
X	238.0	96.0	150.0	70.0	49.0	102.0	141.0	73.0	134.0	64.0	100.0	216.0	235.0	73.0	75.0	36.0	70.0

E. Subfossil skull measurements of Badger (*Meles meles* L.)

<i>Skull no.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>15</i>	<i>16</i>	<i>17</i>
8	119	58	70	43	27	46	68	37	56	28	64	107	116	41	38	17	39
29	127	64	77	49	31	50	78	38	60	31	66	109	118	39	39	20	39
1	122	53	75	42	25	43	75	44	58	27	62	106	112	36	38	18	38
2	115	56	66	39	31	46	67	33	55	29	60	103	110	36	36	17	35
3	117	58	68	41	28	46	69	—	56	—	60	—	—	39	—	17	—
min	115	53	66	39	25	43	67	33	52	27	58	96	105	35	36	16	35
max	127	64	77	49	31	50	78	44	60	31	66	109	118	41	39	20	39
X	120.0	57.8	71.2	42.8	28.4	46.2	71.4	37.2	56.1	28.8	61.6	104.2	112.2	37.6	37.4	17.5	37.2

7. The Upper Palaeolithic fauna from Kalavan 1 (Armenia): preliminary results

Adrian Bălăşescu, Cyril Montoya, Boris Gasparyan, Jérémie Liagre and Christine Chataigner

Discovered in 2004 during the planning of a road along the river Barepat, the open air site of Kalavan 1 is located at an altitude of 1630m a.s.l. in the Aregunyats mountain range, which dominates the northern shore of Lake Sevan in Armenia. In the present state of our knowledge, Kalavan 1 appears to present the first evidence of human presence in the Lesser Caucasus after the Last Glacial Maximum.

The remains of the identified mammals in good stratigraphic context show a predominance of wild Caprinae (Ovis sp. /Capra sp.), among which very few could be attributed to Ovis sp. The human groups of Kalavan 1 hunted wild Caprinae which had reached their maximum weight, thus furnishing a large quantity of meat, as well as other products (hide, bone, tendons, blood, intestines, marrow, etc.).

It is assumed that the species hunted was Ovis orientalis gmelini ('Armenian mouflon'), which migrates seasonally between the valleys during the winter and the high meadows during the summer. Hypothetically, the site of Kalavan 1 could have been occupied at the end of the summer, when the mouflon descended again to the lower altitudes, and the hunters had already procured obsidian to fabricate their hunting arms from the neighbouring deposits surrounding Lake Sevan.

Keywords Upper Palaeolithic, Armenia, Zooarchaeology, Mortality profiles, Ovis sp.

Introduction

Discovered in 2004 during the planning of a road along the river Barepat, the open air site of Kalavan 1 (40° 39' N, 45° 07' E) is located at an altitude of 1630m a.s.l. in the Aregunyats mountain range, which dominates the northern shore of Lake Sevan in Armenia (Fig. 7.1). The French-Armenian excavations which began in 2005 by the 'Caucasus' mission, Ministère des Affaires Etrangères et Européennes (MAEE) and the Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia (NASRA), have revealed two phases of occupation: a hunters' camp dating to the Late Pleistocene (layer 7), and Early Bronze Age tombs dug into the overlying sediments (layers 4–6).

The site and its setting

The site of Kalavan 1 is located in a mountain context at mid-altitude in a narrow valley whose river (Barepat) is a tributary of the Getik, which flows into the Aghstev, then the Kura. All these valleys are in fact ways of access into the Lesser Caucasus mountain chain from the alluvial plain of the middle Kura, which crosses central Georgia and western Azerbaijan. Kalavan 1 is also a few hours walk from Lake Sevan. The site is in the heart of the mountain chain, but the relief is not very steep and the highest slopes (the maximum altitude is about 2700m) are covered with alpine meadows. The altitudinal limit of the forest is located today at about 2100–2200m, but during the cold episodes of the upper Pleistocene it would have been 800–1000m lower (Adler & Tushabramishvili 2004).

In the present state of our knowledge, Kalavan 1 appears to present the first evidence of human presence in the Lesser Caucasus after the Last Glacial Maximum. Part of the glaciers in the Lesser Caucasus retreated and allowed the opening of new territories. Information on the vegetation of the Lesser Caucasus mountains at the end of the Pleistocene is still inexistent, but palynological studies, carried out recently on the neighbouring high plateaus of southern Georgia (Djavakheti) have enabled the restitution of a cold steppe consisting of Chenopodiaceae (*Artemisia* and *Ephedra*), between 14,000 and 11,000 cal BP (Connor & Kvavadze 2008).



Fig. 7.1. Location of Kalavan 1 and other sites mentioned in the article.

The geomorphological analyses (Liagre *et al.* 2009; Ollivier & Nahapetyan 2008) have shown that the first occupants of the camp installed themselves on an old alluvial terrace of the Barepat River, whose sub-horizontal surface includes a slight slope towards the water course (Fig. 7.2). This natural slope would have facilitated solifluction of the layers. A preliminary taphonomic evaluation of the archaeological remains (Liagre & Bălăşescu 2007), as well as of the first spatial distributions of the objects, point to classic disturbances (bioturbations, measured displacements, leaching of hearths). This does not however diminish the techno-typological homogeneity of the material or the relative integrity of the Epipalaeolithic occupations (Montoya *et al.* 2008). This homogeneity is supported by the relative coherence of the dating of the site around 14,000 BP (Liagre & Bălăşescu 2007; Montoya *et al.* 2008; Table 7.1).

*Table 7.1. Radiocarbon dating of bones from Kalavan 1 (OxCal 4.1; calibration dataset: Reimer *et al.* 2009; Cologne calibration program QuickCal2007 ver.1.5: calibration dataset: Weniger & Jöris 2008).*

Code	Square	Date BP	Date cal. BC (OxCal)	Date cal. BC (CalPal)
Poz-19665	GH33	14060±70	15,514–14,910	15,570–15,132
Poz-19664	F22-2	13800±60	15,140–14,786	15,194–14,880
Ly-3537 (GrA)	H 29	14070±60	15,516–14,921	15,576–15,140
Ly-3538 (GrA)	H 29	13750±60	15,102–14,753	15,128–14,794

The occupation of Kalavan 1 thus occurred during Oxygen Isotope Stage 2 (OIS 2), during the warm period of the Greenland Interstadial 1 (GI-1d) but at the time of an abrupt phase of degradation (Fig. 7.3). The climatic improvement at the beginning of GI-1 probably played a major role in the re-occupation of the Lesser Caucasus by mammalian fauna and by prehistoric humans. However, the harsh climatic conditions of the late Pleistocene in the Lesser Caucasus would not have permitted occupation during the winter months.

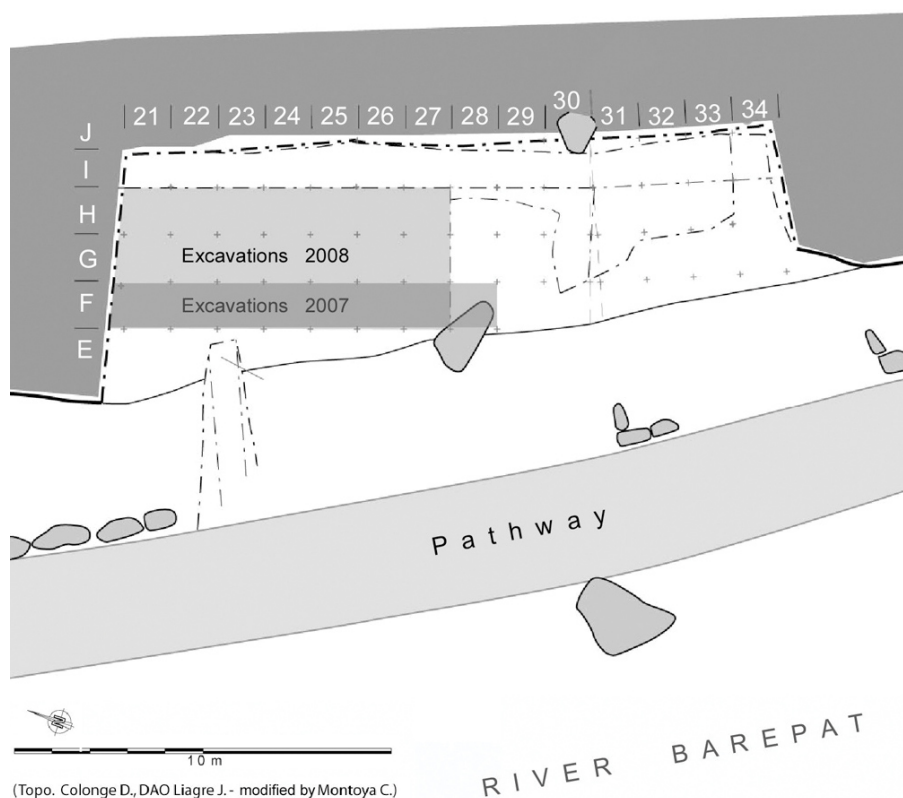


Fig. 7.2. Kalavan 1: plan of the excavation.

The 2007 and 2008 campaigns have shown that layer 7 was composed of several successive occupations (from the earliest to the latest: 7d3, 7d1, 7b), separated by fine sterile strata. The largest zones containing remains were brought to light within horizons 7d3 and 7d1. The composition of the assemblages (lithics and fauna) differs between these two occupations: the faunal remains make up about 39% of the assemblage in 7d3, but only about 11% in 7d1 (Montoya *et al.* 2008). These archaeological levels are marked by a different structuring of the inhabited space, with the discovery of a hearth, refuse zones, faunal middens, and knapping places (Montoya *et al.* 2008).

A few hundred metres from Kalavan 1, on the left bank of the river Barepat, is located another open-air site, Kalavan 2. There, several layers of the Middle Palaeolithic were discovered. An AMS date of a fragment of dental enamel from a large bovid provided an age of $34,200 \pm 360$ BP (38,484–36,514 cal BC) for the Mousterian layer 7, confirming the attribution of this deposit to the final phase of the Middle Palaeolithic and the importance of this site for the study of the last presence of Neanderthals in the Southern Caucasus (Ghukasyan *et al.* 2010). The presence of both Palaeolithic sites on the same territory (Kalavan 1: Upper Palaeolithic and Kalavan 2: Middle Palaeolithic) testifies to the importance of this location for the prehistoric communities of this period.

Material and method

The anatomical and taxonomic determinations of the Kalavan fauna were carried out for the mammals using Schmid (1972). The remains studied are those of wild animals, especially Caprinae, if we take into account the chronology of the site and the faunal spectrum identified. In this preliminary study, we have not been able to have access to comparative data concerning the wild Caprinae of the Caucasus; this is why we have used for our determinations presently available reference species which are domestic (*Ovis aries* and *Capra hircus*) (Boessneck *et al.* 1964; Clutton-Brock *et al.* 1990; Prummel & Frisch 1986). For the teeth we refer to the work of Payne (1985), Helmer (2000), Halstead *et al.* (2002) and Balasse & Ambrose (2005).

We estimated age according to dental eruption, based on Schmid (1972) and dental wear based on the work of Payne (1973) and Helmer (2000). Age profiles, expressed by number of teeth, were set up according to the method proposed in Vigne (1988), Helmer (1992) and Helmer and Vigne (2004). Because of the relatively limited frequency of bones from young individuals and the taphonomic

problems mentioned above, we cannot base age estimation on the degree of epiphyseal fusion, which is highly subject to differential preservation (Vigne 1984); we are thus limited to using the ages suggested by the teeth.

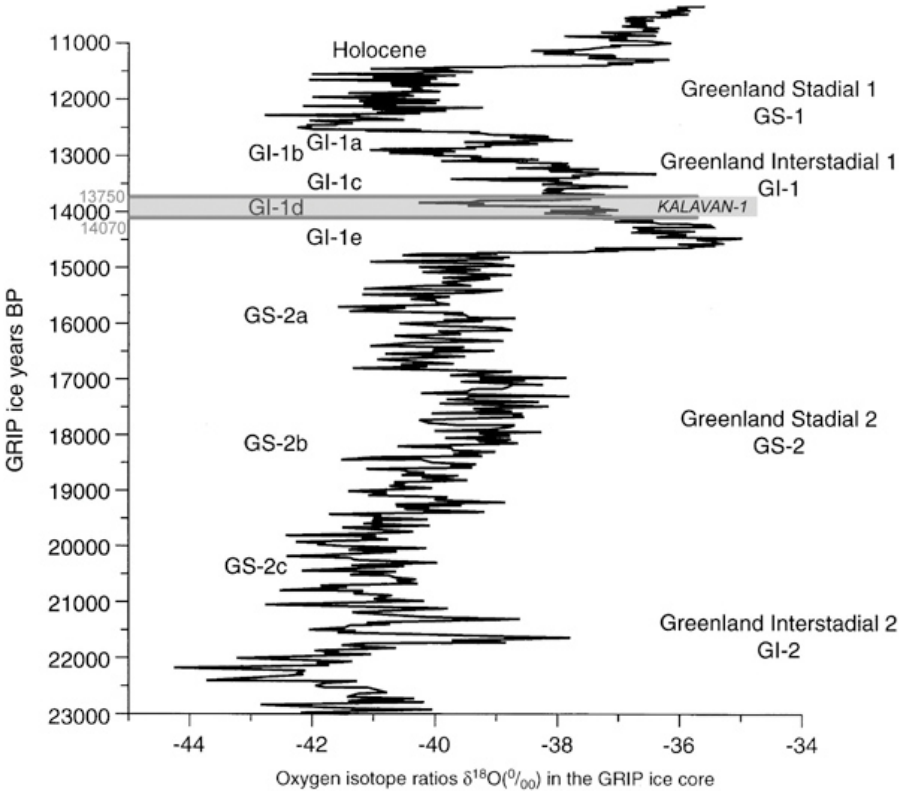


Fig. 7.3. Subdivisions of the oxygen isotope profile 23–11 ka BP (after Walker et al. 1999).

Table 7.2. Distribution of faunal remains found in layer 7 (total), 7d1 and 7d3.

<i>Species</i>	<i>Total layer 7</i>		<i>7d1</i>	<i>7d3</i>	
	<i>NISP</i>	<i>%</i>	<i>NISP</i>	<i>NISP</i>	
wild sheep/wild goat (<i>Ovis</i> sp./ <i>Capra</i> sp.)	400	93.0		150	90.9
wild sheep (<i>Ovis</i> sp.)	26	6.0		15	9.1
<i>Bos/Cervus</i>	3	0.7			
little carnivora	1	0.2			
mammals determined	430	100.0		165	100.0
undetermined I (0–2cm)	969	48.0	7	220	
undetermined II (2–5cm)	883	43.8	6	197	
undetermined III (5–10cm)	158	7.8		56	
undetermined IV (>10cm)	8	0.4		1	
total undetermined	2018	100.0	13	474	
Total	2448	100.0	13	639	

The measurements of the bones were made using a sliding calliper with an instrumental precision to 0.1 of a millimetre. They were taken according to the rules established by von den Driesch (1976).

The total number of faunal remains from layer 7 is high (2448 remains; [Table 7.2](#)). However we will present here only the data from confirmed stratigraphic contexts: horizons 7d1 and 7d3. To maintain the quality of the zooarchaeological analysis, a large part of the faunal remains from sectors of uncertain stratigraphic positions were excluded.

The fauna from horizons 7d1 and 7d3 totals 652 remains (that is 26.63% of the total from layer 7), but almost all the material (90%) comes from 7d3. The 13 faunal remains from 7d1 could not be determined to the level of species; however, 165 of the 639 remains from 7d3 were determined (25.82% of the remains).

State of preservation of the material

As the bones were removed with archaeological sediments in order to better conserve them, and since several bones carried calcareous incrustations which were difficult to remove without destroying the bone itself, we decided not to weigh the fragments.

The state of preservation of the faunal material is very poor and the interpretations which follow must take into account the fact that the results are biased in favour of adult individuals rather than the

youngest animals and the smallest species. Because of the poor state of preservation of the faunal material, it was cleaned in a dry state, as water could have damaged the bones. However, some bone fragments could be joined.

Many bones had become altered before becoming buried (for example, erosion, cracking due to changes of temperature, humidity, etc.). Very few pieces (NISP = 15, 0.6 %) present alterations due to fire (burning traces). Only one fragment presents a carnivore tooth pit. Surface alterations could have erased such marks on most of the bones, as well as traces of butchery (skinning, disarticulation, flesh removal, etc.). We also discovered bones, which had been fractured along their length, presenting percussion marks (point of impact, incipient cone and helicoidal fractures), probably indicating recovery of the bone marrow (Fig. 7.4). The well preserved anatomical elements are isolated teeth, as their chemical composition renders them more resistant to the action of various taphonomic factors.

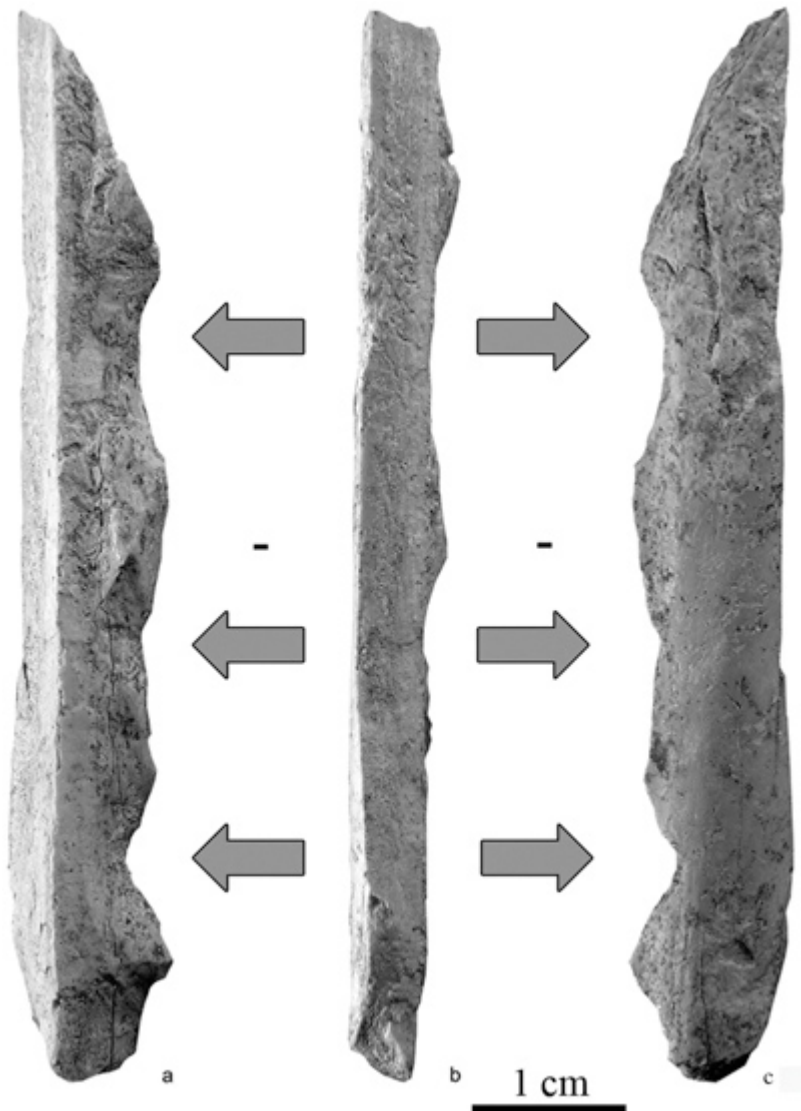


Fig. 7.4. Metapodial of a Caprinae (diaphysis) which presents traces of impact indicative of removal of the bone marrow (red arrow = zone of impact). a – internal view; b – lateral view; c – dorsal view.

The frequency of the skeletal parts recovered, compared to the proportion which they represent in the body ([Table 7.3](#)), indicates for the identified species, that teeth are overrepresented compared to other elements of the skeleton. Moreover, the proportions of the different parts of the long bones of the Caprinae are clearly biased in favour of the diaphyses; the epiphyses which are too fragile for good preservation (Binford 1981; Lyman 1984; 1985; 1992; 1994), are almost completely absent, which makes it difficult to determine the

species.

Most of the faunal remains present longitudinal fractures, which may be related to complex taphonomic processes (freezing – thawing; humidity – drought, etc.), and also to fragmentation due to extraction for obtaining bone marrow and grease (Lyman 1984). Future studies, particularly correlation tests between fragmentation of the bones and their marrow content, will clarify this phenomenon. In our faunal material, no bone presents a whole circumference and 73% of the bones present less than 30% of their circumference, evidence of a high level of destruction of the original bone (Bunn 1982). The length of the unidentified remains is generally 0–2cm (48%) or 2–5cm (43.8%).

Faunal list

The faunal spectrum identified is extremely poor from the point of view of the number of taxa; all the remains belong to mammals.

The remains of the identified mammals show a predominance of wild Caprinae (*Ovis* sp./*Capra* sp.), among which very few could be attributed to *Ovis* sp. (15 pieces, which represent 9.1% of the identified mammal remains). In the present state of the available remains, no element of *Capra* could be determined.

All the other unidentified mammal remains present the same size as the Caprinae, but this does not exclude the possibility that other species of similar size are represented (young wild boar, roe deer, medium-sized carnivores, etc.). The precise determination of the mammals, particularly *Ovis* sp., was made only on the basis of the lower teeth (we have only one exception, one radius). These were found in sufficient quantity to enable the establishment of mortality profiles.

The wild sheep species to which the bones may belong is *Ovis orientalis gmelini* (Armenian mouflon) which is today a threatened species but still survives in Armenia. It is known that three taxa of wild Caprinae are present in the Caucasus: *Capra caucasica* (the West Caucasian tur), *Capra cylindricornis* (the East Caucasian tur) and *Capra aegagrus* (the wild goat).

Within level 7d3, most of the faunal remains come from a large rubbish dump spreading over more than 4m², of which the exhaustive excavation is ongoing (Table 7.3).

Concerning the representation of the identified anatomical parts (Table 7.3), we observe that almost all anatomical parts are in evidence, but with variable frequency. This variability, which is subject to anthropogenic choices and/ or taphonomic factors, is still under evaluation. Where there is a lack of elements, this can be due to

taphonomic processes which could have destroyed some of them (the ulna, the skull except for the teeth, the vertebrae). But it is also possible that the hunters selected certain anatomical parts of the animals at the place of the hunt, as there is a lack of those parts poor in meat: this is the case for the extremities – metacarpal, metatarsal, metapodial and phalanges – 10.9% (Table 7.3) – which could have been left at the spot where the carcass was cut up. On the other hand, it seems that the parts richest in meat were brought onto the site; this is the case for the front limbs (scapula, humerus, radius and ulna) and the hind limbs (pelvis, femur and tibia) which account for 44.8% of the elements (22.4% for the front limbs and 22.4% for the hind limbs). This is also the case for the skull (31.5% of the elements), represented almost exclusively by teeth and the remains of mandibles (51 remains out of 52).

Table 7.3. Distribution of the fauna from horizon 7d3 of Kalavan 1, by species, anatomical elements, body parts and squares.

level 7d3/square	F22			F23			F24			G6	G22	G23		G24		G/H28	Total						
Element anatomic	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	nummal of medium size	Ovis sp.	Ovis sp./ Capra sp.	Caprine total		
Skull				1																			
Maxillary				1					1									1		1			
Upper isolated teeth	1	3		1														6		6			
Mandible				6														7		17			
Lower isolated teeth	1	4		1	6		1	2					2		1	4		19		23			
Teeth				1			2										5			5			
HEAD	2	8		7	12	1	1	6	1			3	4		1	7		14 (93.3%)	38 (25.3%)	52 (31.5%)			
Cervical Vertebra																							
Rib	1			14						1		2						21		21			
AXIAL				14	1		3			1		2						21 (14%)		21 (12.7%)			
Scapula	1			2			1										5		5				
Humerus				5	1		1			3		2					14		14				
Radius	1	5		2			3			2				1		2	1	15		16			
Ulna				1													1		1				
Radius-Ulna				1								1					1		1				
FRONT LIMBS	1	7		11	1		7			5		3	1		1	2	1 (6.7%)	36 (24%)	37 (22.4%)				
Femur		3		9			2			2		2		1			18		18				
Tibia		3		12	1		2	1		1				1			19		19				
HIND LIMBS		6		21	1		4	1		3		2					37 (24.7%)		37 (22.4%)				
Metacarpal				1													2		2				
Metatarsal				3			2								1			6		6			
Metapodial				3			1			1		1					6		6				
Phalanx 1				2			1										3		3				
Phalanx 2	1																1		1				
EXTREMITIES	1			9			4			1		1					18 (12%)		18 (10.9%)				
long-bones		229			92			56	3		12	33		24									
flat bones											2												
TOTAL	3	23	229	7	67	96	1	24	58	3	10	14	3	12	34	1	11	24	3	16	15	150	165

Mortality profiles

The teeth, better preserved than other elements of the skeleton, allow age determination of the Caprinae at the moment of death. The sample of lower and upper teeth studied is ample enough (71 teeth) to construct a mortality profile for the Caprinae discovered in horizon 7d3.

The study of age profiles of the Caprinae (Fig. 7.5) shows a predominance of animals of class D (between 1 and 2 years) with a

percentage of 47.7%, followed by older animals of class EF (2–4 years), at 33%, and G (4–6 years) at 14.6%. We must point out that the age classes represented in [Figures 7.5](#) and [7.6](#) are corrected. According to these data, it appears that in our sample, the Caprinae that have already reached a considerable weight (nearly the maximum weight) are predominant. This could indicate a selective hunting of the animals which provided a larger quantity of meat of very good quality. In addition, the only tooth that suggests class C is a molar (M1/M2), which cannot be clearly attributed to class C or to class D; the metric data situate it between the two classes and do not permit determination as either M1 or M2.

The mortality profile of the sheep, based on the determined lower teeth (NISP=53), present the same tendency towards selection of the animals hunted ([Fig. 7.6](#)): the Epipalaeolithic human group hunted animals between 1 and 4 years of age (class D and EF) which had reached a maximum weight.

The mortality profiles for the Caprinae found in horizon 7d3 shows the absence of very young animals, as so far no teeth of Caprinae aged 0–2 months (class A) or 2–6 months (class B) have been discovered. Thus it appears that the hunters did not seek out the young animals, which did not provide much meat, and it may be that they ‘preserved’ them for the future, for hunting in a later season. This could indicate a true hunting strategy that preserved the immature animals.

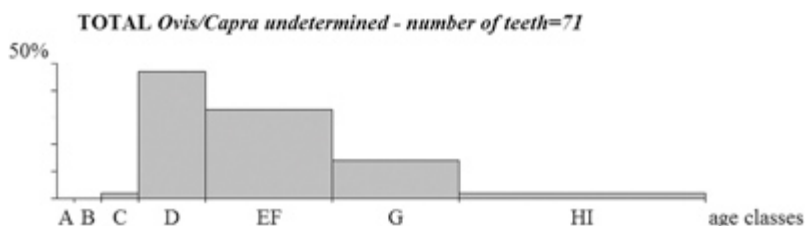


Fig 7.5. Age profile of Caprinae (Ovis sp./Capra sp.) in classes of age (after Payne 1973), discovered at Kalavan in 7d3.



Fig. 7.6. Age profile of Caprinae (Ovis sp) in classes of age (after Payne 1973), discovered at Kalavan in 7d3.

An estimate of the minimum number of individuals among the

Caprinae shows the same predominance of animals whose age corresponded to a weight close to the maximum (Table 7.4). Unfortunately, it was not possible to identify remains of horncores, i.e. evidence for the sex of the animals. The reasons are the poor preservation of the faunal material, as well as the taphonomic processes, which destroyed these remains.

The species of *Ovis* hunted by the Epipalaeolithic community of Kalavan is probably *Ovis orientalis gmelini*. This species presents great sexual dimorphism; these animals migrate seasonally, between the high meadows in summer and the lowlands in winter. They prefer the meadows, but are also found in wooded zones. The rutting season occurs between mid-October and the end of November, with a peak of activity in the first part of November; the females give birth to one or two lambs in April (Valdez 2008).

The observation of mouflons has provided insight into some important behavioural characteristics and into the biology of the species. Except for the rutting season, the males are more difficult to observe than the females, because they live apart from them. The females form herds of 10–12 individuals with their young, and exploit environments usually different from those of the males (Cransac & Hewison 1997).

Based on the ecology and the ethology of this species (*Ovis orientalis gmelini*), it is probable that the Caprinae were hunted in the best season. To seek the best pastures, animals migrated between the summer to autumn from the valleys to the high meadows and vice versa. It should be reminded that the site of Kalavan 1 is located at an altitude of 1630m. This working hypothesis, however, must be verified in the future by other methods of research, particularly by the development of palaeo-environmental studies, e.g. palynology and isotopes studies (Balasse 2002; Balasse *et al.* 2002; 2003).

Table 7.4 The minimum number of individuals of Ovis sp and of Caprinae (Ovis sp./Capra sp.), discovered at Kalavan 1, by age class (after Payne 1973).

<i>Age classes (Payne, 1973)</i>		<i>Ovis sp.</i>	<i>Ovis sp./ Capra sp.</i>	<i>Total MNI</i>
A	0–2 months			
B	2–6 months			
C	6–12 months		1	1
D	1–2 years	2		2
EF	2–4 years	5		5
G	4–6 years	2	2	4
HI	6–10 years	1		1
Total	MNI	10	3	13

Discussion

In the Caucasus region, data on the Upper Palaeolithic are rare, and in Armenia Kalavan 1 is so far the only site excavated. However, in Georgia several sites have been studied, some open-air and others in caves (Adler *et al.* 2006; Lioubine 1989; 1992; Nioradze & Otte 2000), among which (Fig. 7.1): Samertskhle Klde ($20,160 \pm 160$ BP; OxA-7854), Gvardjilas Klde ($15,960 \pm 120$ BP; OxA-7855 and $15,010 \pm 110$ BP; OxA-7856) (Nioradze 2001; Nioradze & Otte 2000) and Dzudzuana – Unit B ($13,830 \pm 90$ BP; $13,250 \pm 70$ BP; $11,500 \pm 75$ BP) (Meshveliani *et al.* 2007).

Concerning the information on the fauna of these sites, we observe that the data are very incomplete for Samertskhle Klde and Gvardjilas Klde; only Dzudzuana cave was the subject of detailed analysis (Bar Oz *et al.* 2008). The principal characteristic of these sites is the diversity of the faunal spectrum, which contrasts with that of Kalavan 1: at Gvardjilas Klde, 14 taxa were identified, 7 at Samertskhle Klde and 12 at Dzudzuana. The diversity and richness of these Georgian Palaeolithic faunas is probably related to the various topographic positions of these sites and that of different biotopes near these (valley bed, hill, plain), whose altitudes vary between 340m and 800m (Nioradze & Otte 2000), while Kalavan 1, a mountain site lies at 1630m. Moreover, the conditions of preservation of the bones in caves are better than on the open-air sites, which are more exposed to climatic variations (humidity, temperature, etc.).

If we consider the high altitudes to be a determining factor in the reduction of the faunal spectrum for the taxa of medium and large mammals, we may suppose that the list of fauna for Kalavan 1 is rather the reflection of a part of the mammalian biomass living in this

environment at 14,000 years BP. It is possible however to qualify this hypothesis. The faunal spectrum found at Kalavan 1 results from the hunting activity of human groups and the choices made by them. These choices, which still remain to be determined precisely, were made on the basis of socio-economic but also cultural factors. Until complementary analyses are made, the idea of mass hunting of a deliberately reduced spectrum to satisfy specific needs (reserves of meat and hides) should not be excluded.

At Dzudzuana, the zooarchaeological analysis of level B has shown the predominance of the remains of *Capra caucasica* (50.76%); followed by those of a large bovid (*Bos/Bison* – 42.68%); the zooarchaeological data suggest an occupation of the site between the spring and the autumn. Similar behaviour was revealed in the neighbouring site of Ortvale Klde (Adler *et al.* 2006), where in both the Middle and the Upper Palaeolithic, hunting Caprinae (in this case, ibexes, *Capra caucasica*) was predominant (more than 90% of the fauna).

At Kalavan 1, only the remains of *Ovis* sp. were identified. The mouflon (*Ovis orientalis*) appears rarely in the faunal spectra of the Upper Pleistocene in the Caucasus. It is present in the Mousterian caves of Barakaevskaya and Mezmaiskaya, on the northwest flank of the Greater Caucasus (Baryshnikov & Hoffecker 1994; Baryshnikov *et al.* 1996), but does not seem to be in evidence in Georgia (Fig. 7.1).

At Kalavan 1, Ortvale Klde and Dzudzuana, one observes the same predominance of species of artiodactyls that present similar behaviour, based on seasonal migrations. It is clearly not opportunist hunting, but targeted hunting of one species of ungulate (Adler *et al.* 2006), which implies both an ethological knowledge of the prey over time (migrations) and space (routes taken), an anticipatory behaviour (being in the right place at the right time), coordination of the group, as well as the preparation of weapons envisaged for the hunt.

At Kalavan 1, it is remarkable that most of the tools are obsidian (about 66%), which is not from this region, while the local siliceous rocks washed down in abundance by the river Barepat only played a supplementary role. Provenance analyses carried out on 18 obsidian artefacts have shown that this material came from several deposits located west of Lake Sevan (Geghasar, Gutansar, Hatis), only one sample being from a source south-east of Lake Sevan (Sevkar). The obsidian outcrops at Geghasar and Sevkar lie at altitudes between 2700m and 3000m, in regions which are today covered by snow 6 months of the year; obtaining obsidian could thus only take place during the summer. GIS modelling of the time necessary to cover the

distance between the site of Kalavan and the sources of obsidian over the relief, indicates that 23–30 hours would have been necessary to reach the three main deposits (Gutansar, Geghasar and Hatis), i.e. 3–4 days' walk (Barge & Chataigner 2004; Fig. 7.7).

It seems probable then that the hunters of Kalavan went first to supply themselves with obsidian, walking over the mountains that surround Lake Sevan, in order to prepare weapons for hunting mouflon.

Moreover, for Ortvalde Klde, Adler *et al.* (2006) have shown that the targeted hunting of the ibex was by ambush, the hunters lying in wait along the migration routes of the animals and not between the rocks where the animals were beyond their reach. This scenario can also serve as a hypothesis for Kalavan 1, as the valley of the Barepat probably corresponds to a migration route between the peaks dominating Lake Sevan and the valleys of the Kura basin. In this hypothesis, it would have been at the end of the hottest season, when the herds of mouflon descended into the valley floor, that the hunters of Kalavan lay in wait to cut them down in a narrow part of the Barepat valley.



Fig. 7.7. Time of access between Kalavan 1 and the obsidian deposits (by stages of 7 hours).

Conclusion

Preliminary faunal analyses show that the human groups at Kalavan 1 hunted wild Caprinae which had reached their maximum weight, thus furnishing a large quantity of meat, as well as other products (hide, bone, tendons, blood, intestines, marrow, etc.). Data on the age of the Caprinae show an absence of very young animals (0–6 months) which could suggest management of the resource with a choice on the part of the hunters to not kill the latter, which would have had comparatively little meat on them, but rather to ‘preserve’ them for a future seasonal hunt.

It is assumed that the species hunted was *Ovis orientalis gmelini* (‘Armenian mouflon’), which migrates seasonally between the valleys during the winter and the high meadows during the summer. Hypothetically, the site of Kalavan 1 could have been occupied at the end of the summer, when the mouflon descended again to the lower altitudes, and the hunters had already procured obsidian to fabricate their hunting arms from the neighbouring deposits of Lake Sevan. An analysis of the lithic technical system is in progress in order to define the socio-economic behaviour of the human groups which occupied Kalavan 1.

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8. Neolithic subsistence economy in the plain of Ararat: preliminary comparative analysis of the faunal remains from Aratashen and Khaturnarkh-Aknashen (Armenia)

Emmanuelle Vila, Adrian Bălăşescu, Valentin Radu, Ruben Badalyan and Christine Chataigner

This contribution presents a preliminary comparative analysis of the archaeozoological data from two Neolithic sites in the plain of Ararat in Armenia: Aratashen and Khatunarkh-Aknashen, occupied during the 6th millennium BC. The Neolithic period is poorly known in Armenia from the point of view of subsistence modes. Comparison of the results of the studies on the fauna reveals many similarities. The animal economy rested largely on the exploitation of domestic animals, especially sheep and goats, but the mode of exploitation varied from one site to the other. Cattle played a relatively modest role and pigs are rare on the two sites; we observe a clear increase in the exploitation of cattle in the latest levels of the occupations. The contribution of hunting is limited. The large ungulates are present: red deer, aurochs, wild horses, wild boar, as well as the smaller ones: roe deer, wild Caprinae, gazelles. The remains of bear, wolf, small carnivores, beaver, and hare have also been identified on one or the other site. Fishing was practised very little. The variety of wild taxa indicates an exploitation of the environments near the sites, the Kasakh river, the plain of Ararat and the neighbouring mountains.

Keywords Neolithic, archaeozoology, age profiles, Armenia, Animal economy

Introduction

Studies of fauna and archaeozoological data are not very numerous for the Neolithic and Chalcolithic periods in Armenia, because, until recently, these periods were known by the excavations of a single site, Tekhut (Torosyan 1976), and by soundings on a few tells. Since 2000, the excavations carried out on two Neolithic occupations situated in the Ararat plain, Aratashen and Khatunarkh-Aknashen, have enabled collection of fairly abundant well-stratified faunal material for which the processing of the data is in progress. This material provides new information on the subsistence modes of these Neolithic societies, and the comparative study of these two neighbouring sites is intended to produce elements for understanding how they functioned.

The sites are 6 km apart. They are located 30 km west of Yerevan in the meanders of the Kasakh river, which flows into the Arax a few kilometres to the south (Fig. 8.1). At the present time, Aratashen is situated on the edge of the Kasakh river and Khatunarkh-Aknashen lies a few hundred meters from the river. The environment and present-day landscape of these two sites are quite similar.

The site of Aratashen was excavated from 1999 to 2004 under the direction of R. Badalyan (Institute of Archaeology, Yerevan) and P. Lombard (CNRS, Archéorient, Lyon) as part of the joint Franco-Armenian study programme of the Neolithic and Chalcolithic culture of Armenia ('Caucasus' Mission directed by C. Chataigner – CNRS, Archéorient, Lyon). Unpublished excavations were carried out in the 1970s by S. A. Sardaryan and at the end of the 1980s by S. Aslanyan. For recent Franco-Armenian excavations, synthetic articles have been published (Badalyan *et al.* 2004; 2007) and the final publication of this research programme is in preparation.

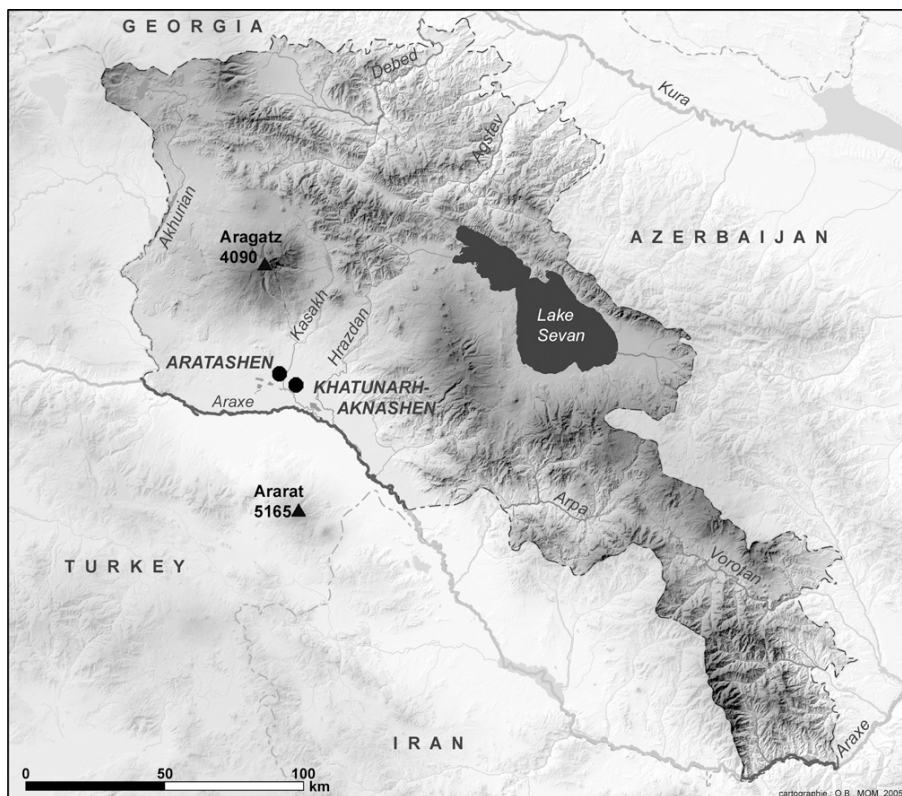


Fig. 8.1. Map of Armenia and location of the two sites of Aratashen and Khatunarkh-Aknashen.

The site of Khatunarkh-Aknashen (old name: Khatunarkh, present name Aknashen) has been excavated since 2004, under the direction of R. Badalyan, also as part of the Caucasus Mission. Trenches were dug in the 1970s by the archaeologist R. M. Torosyan (Torosyan *et al.* 1970).

The stratigraphic levels of Aratashen and Khatunarkh-Aknashen cover the Neolithic and Chalcolithic phases of the regional culture of the Ararat plain. The two sites hold great importance for understanding the late prehistory of Armenia and the southern Caucasus. The faunal studies were carried out during stays in Armenia between 2001 and 2009. This contribution presents a preliminary comparative analysis of the two sites, inventories of the species present and analyses of the kill-off ages concerning the most frequent taxa, the Caprinae. The faunal studies are in progress and will be published in their entirety in the monographs on the sites that are being prepared.

Sequence of occupation at Aratashen

At Aratashen, the stratigraphic sequence consists of two main horizons of Neolithic occupation: horizons I and II; a last very eroded horizon which we will not deal with here is horizon 0, considered to be Early Chalcolithic in the present state of the data. Horizon II, the earliest, is related to the Shulaveri-Shomu culture and is divided into four sub-phases (IIa–IIe) (cf. Badalyan *et al.* 2007, table 1). The architecture is dense and complex (round houses with cells built with pisé and rarely with mud bricks). The pottery appears only in horizon IIb and is very similar to the Shulaveri-Shomu pottery (Palumbi 2007). The bone industry, mainly on deer antlers, but also on tibias and metapodia of Caprinae as well as scapulae of cattle, is abundant and highly varied. The faunal remains are numerous. The dates currently obtained for horizon II are coherent (calibrated 2 sigmas, IIa: 5563–5481 cal BC and 5792–5625 cal BC; IIb: 5878–5775 cal BC; IIc: 5791–5631 cal BC, 5848–5658 cal BC and 5905–5711 cal BC), placing the occupation at the beginning and during the first half of the 6th millennium BC (Badalyan *et al.* 2007). A strong break in the architecture and the objects exists between horizon II and horizon I. Horizon I is characterised by large architectural structures built with a particular type of mud bricks, the presence of pottery, few bone objects, few faunal remains.

Sequence of occupation at Khatunarkh-Aknashen

At Khatunarkh-Aknashen, a complete stratigraphic sequence was obtained in trench A: 15 individualised stratigraphic units in the excavation correspond to five horizons: I–V of which the three earliest date from 6000 to 5000 cal BC. The dates obtained so far are fairly coherent (III: 5480–5080 cal BC; IV: 5620–5370 cal BC, 5840–5669 cal BC; V: 5890–5660 cal BC; 5980–5660 cal BC and 6024–5753 cal BC; cf. Chataigner 2007). Horizon V, the earliest, is divided into five sub-phases (V1–V5). As the processing of the stratigraphic and archaeological data is not yet completed and the dating of horizons I and II has not yet been carried out, the stratigraphic propositions made here are preliminary and the chronological attributions of certain stratigraphic units need to be verified. In the present state of the study, horizon I at Khatunarkh-Aknashen, the latest, which is not dealt with in this contribution, would correspond to the Chalcolithic. Horizon II, poorly preserved, and horizon III share the same characteristics: buildings of circular plan with pisé (and rarely mudbrick) walls, tamped earth floors, abundant pottery with mainly mineral temper and a small quantity of bone industry. Horizons IV

and V possess construction techniques similar to those of the following occupations; however, unlike horizons II and III, pottery is very rare (horizon IV) or absent (horizon V) while the bone industry is abundant and varied.

According to the objects and the similarity in dates, it would seem that the earliest horizons of Khatunarkh-Aknashen (Kha V and Kha IV)¹ are approximately contemporary to horizon II of Aratashen (Ara II). Horizons II and III of Khatunarkh-Aknashen (Kha II and Kha III) could be attributed to the period immediately before, thus generally contemporary to horizon I of Aratashen (Ara I).

Methods

The inventory and the practical study of the fauna at Khatunarkh-Aknatashen and Aratashen were carried out in the field. The recovery of the bone remains was mainly by hand; certain sediments were sieved for the archaeobotanical studies, but the fauna from sieving was not abundant and very fragmentary. The anatomical and taxonomical determinations for the mammals were carried out using the works of Barone (1986), Schmid (1972), Pales and Lambert (1971), Pales and Garcia (1981), Fernandez (2001) and Brugal (2009). Among the pieces of which the determination was difficult without a bone reference collection, some were taken to Europe to refine the diagnosis with the help of available osteological references. The discrimination between goat and sheep is based, on the one hand, on analysis of the postcranial elements (Boessneck *et al.* 1964; Clutton-Brock *et al.* 1990; Prummel & Frisch 1986), and on the other hand on the dental remains determined according to the criteria established by Payne (1985), Helmer (2000), Halstead *et al.* (2002) and Balasse and Ambrose (2005). The dates for dental eruption are based on the data in Schmid (1972); the estimates of age according to dental wear are based on the work of Payne (1973) and Helmer (2000) for the Caprinae. The kill-off profiles for the Caprinae have been established based on the heights of dental crowns (cf. Helmer *et al.* 2007).

Inventory of species

At Aratashen, the excavation finished in 2005 and the practical study of the faunal material has been completed. More than 16,000 faunal remains were recovered in horizons I and II, among which more than 5000 were identified taxonomically (Fig. 8.2). The number of remains is variable in the sub-phases of horizon II: sub-phases IIa and IIb have produced large quantities of fauna (more than 3000 fragments); however, sub-phases IIb/c, IIc and IIc/d have produced fewer

quantities of fauna (less or equal to 1000 fragments). Many of the bones carry concretions on the surface. For the mammal species, the domestic fauna are represented by the domestic Caprinae, i.e. sheep (*Ovis aries*) and goat (*Capra hircus*), cattle (*Bos taurus*), dogs (*Canis familiaris*) and probably domestic pig (*Sus domesticus*). The wild fauna is rare but very diversified: red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), wild goat (*Capra aegagrus*), mouflon (*Ovis cf. orientalis*), roe deer (*Capreolus capreolus*), gazelle (*Gazella* sp.), bear (*Ursus cf. arctos*), wolf (*Canis lupus*)², fox (*Vulpes vulpes*), wild cat (*Felis sylvestris*), beaver (*Castor fiber*) and hare (*Lepus* sp.). The remains of a tortoise, two fish remains – tench (*Tinca tinca*) and a member of the Cyprinidae – and a few bird bones were also found in the Neolithic horizons. It should be noted that antler fragments from red deer, among which are shed antlers, are numerous, particularly in sub-phases IIa and IIb (Figs 8.3–8.8).

At Khatunarkh-Aknashen, the excavation is in progress. The analysis presented here includes the faunal material recovered up to 2009. At the present time, more than 12800 remains of fauna have been studied, among which more than 5500 have been determined to taxonomic level (45% of the total number of remains) (Fig. 8.9). Horizons II, III and IV have produced more than a thousand fragments, however the sub-phases of horizon V have produced less than 1000 fragments. Sub-phase V-5 does not appear in the illustrations as the number of remains is very low (23 fragments). Some 20 taxa have been identified: two fish – the common carp (*Cyprinus carpio*) and a catfish (*Silurus glanis*), a reptile (tortoise), a bird, and 15 species of mammal. The domestic species are Caprinae, i.e. sheep (*Ovis aries*) and goat (*Capra hircus*), cattle (*Bos taurus*), and dog (*Canis familiaris*); pig (*Sus domesticus*) is probably present. The wild taxa are numerous: aurochs (*Bos primigenius*), wild boar (*Sus scrofa*), horse (*Equus* sp.), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), gazelle (*Gazella* sp.), hare (*Lepus* sp.), fox (*Vulpes vulpes*), wild cat (*Felis sylvestris*), wolf (*Canis lupus*), bear (*Ursus arctos*), beaver (*Castor fiber*), hedgehog (*Erinaceus* sp.), a small mustelid (*Mustela* sp.) and wild Caprinae, i.e. mouflon (*Ovis cf. orientalis*) and wild goat (*Capra aegagrus*) (Figs 8.10–8.15).

NUMBER OF REMAINS Aratashen		I NRM	Ila NRM	Ilb NRM	Ilb/Ilc NISP/NRM	Ilc NRM	Ilc/Ild NRM	Ild NRM	TOTAL
<i>Ovis aries</i>	sheep	106	193	287	32	99	62	130	909
<i>Capra hircus</i>	goat	23	55	81	4	28	19	38	248
<i>Ovis aries/Capra hircus</i>	sheep/goat	390	613	986	129	215	157	402	2892
<i>Sus domesticus</i> ?	pig	5	11	26	2	4	4		52
<i>Bos taurus</i>	cattle	94	136	70	17	19	11	33	380
<i>Ovis orientalis</i>	mouflon	1				1			2
<i>Capra aegagrus</i>	wild goat		1	2					3
<i>Capreolus capreolus</i>	roe deer		2						2
<i>Gazella</i> sp.	gazelle			1					1
<i>Sus scrofa</i>	wild boar		2	7					9
<i>Cervus elaphus</i>	red deer (without antlers)	14	16	119	3	11	13	2	178
<i>Bos primigenius</i>	aurochs	1		1					2
<i>Ovis/Capra/Capreolus/Gazella</i>	small and medium ruminants	26	144	172	21	80	23	91	557
<i>Bos/Cervus</i>	large ungulates	15	22	30	2	1	3		73
<i>Canis familiaris</i>	dog	10	18	7	2	13	3	3	56
<i>Ursus arctos</i>	bear	1		1					2
<i>Canis lupus</i>	wolf					1	1		2
<i>Vulpes vulpes</i>	red fox	4	2	4		5	1	2	18
<i>Felis sylvestris</i>	wild cat			1					1
<i>Castor fiber</i>	beaver	1		1					2
<i>Canis/Vulpes/Felis</i>	small carnivores	1	3	3					7
<i>Lepus</i> sp.	hare	3	3	4		2	3		15
Total mammal, identified		695	1221	1803	212	479	300	701	5411
Small mammals, unidentified		756	1570	3201	309	479	301	1529	8145
Large mammals, unidentified		229	393	506	54	51	59	97	1389
Total mammal remains		1680	3184	5510	575	1009	660	2327	14945
Bird		2		5		1		1	9
Fish			1					1	2
Tortoise				1					1
Homo		6		2		1	1		10
<i>Cervus elaphus</i>	antlers	8	17	50	5	6	2	7	95

NRM: number of remains (we considered one individual unit all associated parts, in connection or fragments of the same bone)

Fig. 8.2. List of animal species at Aratashen.



Fig. 8.3. Fragment of deer skull with attached antler (lateral view) – Aratashen (scale unit: 1 cm).



Fig. 8.4. Shed antler of deer (lateral view) – Aratashen (scale unit: 1 cm).



Fig. 8.5. Bear astragalus (dorsal view) – Aratashen (scale unit: 1 cm).



Fig. 8.6. Fox mandible (lateral view) – Aratashen (scale unit: 1 cm).



Fig. 8.7. Beaver femur (cranial view) – Aratashen (scale unit: 1 cm).



Fig. 8.8. Tortoise shell – Aratashen (scale unit: 1 cm).

A certain number of common taxa among the wild mammal fauna are found on both sites, except the horse and the hedgehog, only in evidence at Khatunarkh-Aknashen.

Comparison of the frequencies of the domestic and wild animals on the two sites shows a predominance of domestic species in all the sub-phases (Fig. 8.16) and an animal economy that clearly relied on herding. Overall in the two occupations, the frequencies of wild fauna are low and are slightly higher than 10 % only in horizons Kha II and III and horizon Ara IIb.

Frequencies of domestic species

The frequencies of Caprinae are very high and clearly dominate those of other domestic species from the earliest sub-phases to the latest sub-phases on both sites (Fig. 8.17). The Caprinae herds consisted mainly of sheep at both Khatunarkh-Aknashen and Aratashen. Goats represent, depending on the sub-phase, from 33.3% to 1.25% or less of the herds. The remains of pig are rare and their domestic or wild status poses a problem. Some are very certainly wild because of their robust size, but the presence of the domestic pig as well as the domestic-wild ratio has not been completely elucidated. The remains

of dog are few on both sites throughout the occupations. A change is observed in the frequencies of the Caprinae between the horizons: they decrease with the increase of those of cattle over time. This is very clear at Khatunarkh-Aknashen beginning in horizon Kha IV. At Aratashen, the same phenomenon, although less marked, appears beginning with horizon Ara IIa. Comparison of the earliest horizons (Kha V and Ara II) with the latest horizons (Kha III-II and Ara I) on the two sites clearly shows the change, with an increase in the exploitation of cattle in the latest horizons of both sites (Fig. 8.18).

Frequency of wild species

Wild fauna is present in all horizons of the two sites in limited proportions, but with varying taxa, as there are large and medium-sized ungulates such as the aurochs, the red deer and the wild boar, as well as a certain number of small ruminants; gazelle, roe deer and wild Caprinae, i.e. mouflon and wild goat, are clearly in evidence. Then there are carnivores, large – bear and wolf, and smaller – badger, fox and cat, common to both sites; and a *Mustela* sp. at Khatunarkh-Aknashen. Finally, large rodents, hare and beaver are present on both sites. The major difference between Khatunarkh-Aknashen and Aratashen in the faunal spectrum concerns the proportions of wild taxa found on the two sites (Fig. 8.19). Figure 8.5 includes all pig remains, given the difficulty of differentiating the domestic and wild status of pigs, although a specific attribution for certain remains because of their size – slender or robust – is proposed in the tables.

Hunting at Khatunarkh-Aknashen, as much in the earliest horizons (Kha V–IV) as in the latest (Kha III–II) is not very selective and does not concern any particular species. However, in the early sub-phases, the Cervidae and the small wild ruminants represent the most frequent game hunted. In the late sub-phases (Kha III–II) where the frequencies of hunting increase, (cf. Fig. 8.18), no species is particularly targeted; however, the type of game changes: the proportions of Cervidae and small wild ruminants are less while those of suids, different types of carnivores as well as equids (horses) are higher. It is particularly in horizon Kha II (cf. Fig. 8.16) that we observe an increase in the remains of wild taxa. It is also in this horizon that the remains of horses, one in Kha IV, eight in Kha III, are the most numerous (NR=16), that is, in the latest horizon of the occupation of Khatunarkh-Aknashen. It is absent in the earliest horizon Kha V.

The situation is different at Aratashen, as on the one hand the horse is absent in all the horizons, even in horizon Ara I, contemporary to

Kha III and Kha II. On the other hand, the frequencies of the large Cervidae are higher than those of other taxa, as much in the sub-phases of the earliest horizon Ara II as in the latest, Ara I. Hunting was thus more selective, focussed on the red deer, whose remains, antlers and bones, are particularly abundant in level Ara IIb. In spite of the limited number of remains, there can be seen in the latest horizon Ara I an increase in the proportions of carnivores and rodents as well as a slight decrease in those of the Cervidae, while the proportions of suids do not vary. As in horizon Kha III-II of Khatunarkh-Aknashen, the diversification of the wild taxa appears to increase in horizon Ara I. If we consider the limited number of the remains of wild taxa, the anecdotal aspect of hunting activity is almost constant on both sites. It must be noted, however, that this hunting concerns a very large spectrum of species, among these the large mammals and dangerous species such as the aurochs, the wild boar, the red deer, the bear and the wolf. This type of hunting involved certain risks, probably compensated by the large quantity of meat and the acquisition of other products such as antlers, horns and hides, although its purpose could also have been to protect crops, herds and humans. In any case, the importance of red deer antlers is well illustrated by the presence of shed antlers on both sites; moreover, at Aratashen the many objects made from antlers and bones of red deer are evidence of the importance of craftwork in these raw materials.

NUMBER OF REMAINS		I	II	III	IV	V-1	V-2	V-3	V-4	V-5	TOTAL
Khatunarkh-Aknashen		NRM	NRM	NRM	NRM	NRM	NRM	NRM	NRM	NRM	
<i>Ovis aries</i>	sheep	3	23	78	97	37	20	29	51		338
<i>Capra hircus</i>	goat		5	27	23	5	8	4	11		83
<i>Ovis aries/Capra hircus</i>	sheep/goat	42	278	1077	1646	300	135	168	301	10	3957
<i>Sus domesticus</i>	pig		3	2	1		1				7
<i>Bos taurus</i>	cattle	13	113	238	290	65	14	18	20	3	774
<i>Bos taurus/Bos primigenius</i>	Bovines	1	12	2	7	1			5		28
<i>Equus sp.</i>	Equids	1	16	8	3						28
<i>Capra aegagrus</i>	wild goat			2				1			3
<i>Ovis sp./Capra sp.</i>	wild Caprinae			5	7	2	3	3	11		31
<i>Capreolus capreolus</i>	roe deer		2	7	1	2					12
<i>Gazella sp.</i>	gazelle	2	3	55	28			1			89
<i>Sus scrofa</i>	wild boar		2	14	3	1					20
<i>Sus sp.</i>	Suids		9	16	10			1			36
<i>Cervus elaphus</i>	red deer (without antlers)		4	52	53	3			6		118
<i>Bos primigenius</i>	aurochs		5	8	3			1			17
<i>Ovis/Capra/Gazella/Capreolus</i>	small and medium ruminants		1	26	26			1			54
<i>Bos/Equus/Cervus</i>	large ungulates			15	12	4	1	2	5	1	40
<i>Canis familiaris</i>	dog	1	7	13	11	2	5	1	4		44
<i>Ursus arctos</i>	bear				1						1
<i>Canis lupus</i>	wolf				1						1
<i>Vulpes vulpes</i>	red fox		4	9	11						24
<i>Felis sylvestris</i>	wild cat							1			1
<i>Petitis carnivores</i>	small carnivores			10	1						11
<i>Petit mustelide</i>	small mustelids		2	2	1						5
<i>Lepus sp.</i>	hare	1	12	24	28	3		1	2		71
<i>Castor fiber</i>	beaver			1	2						3
<i>Erinaceus sp.</i>	hedgehog				2						2
Total mammals identified		64	501	1691	2268	425	187	232	416	14	5798
<i>Small mammals unidentified</i>		66	1005	1675	2603	261	161	304	161	9	6245
<i>Large mammals unidentified</i>		3	107	430	203	29	24	24	15		835
Total mammals		133	1613	3796	5074	715	372	560	592	23	12878
Microfauna					1						1
Bird			1	5	8						14
Reptilia			1	2							3
Amphibia				1							1
Fish		1	3	14	29						47
<i>Cervus elaphus</i> (antlers)			9	16	10			2			37

NRM: number of remains (we considered one individual unit all associated parts, in connection or fragment of the same bone)

Fig. 8.9. List of animal species at Khatunarkh-Aknashen.



Fig. 8.10. Common carp vertebra (lateral view) – Khatunarkh-Aknashen (scale unit: 1 cm).



Fig. 8.11. Catfish vertebra (cranial view) - Khatunarkh-Aknashen (scale unit: 1 cm).



Fig. 8.12. Horse calcaneum (medial view) - Khatunarkh-Aknashen (scale unit: 1 cm).



Fig. 8.13. Skull of gazelle with horncore (lateral view) -Khatunarkh-Aknashen (scale unit: 1 cm).



Fig. 8.14. Wild cat mandible (lateral view) - Khatunarkh-Aknashen (scale unit: 1 cm).



Fig. 8.15. Hare mandible (lateral view) - Khatunarkh-Aknashen (scale unit: 1 cm).

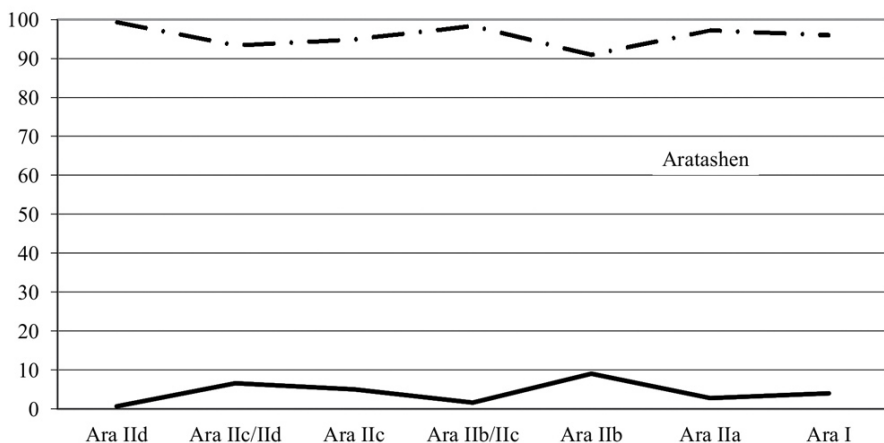
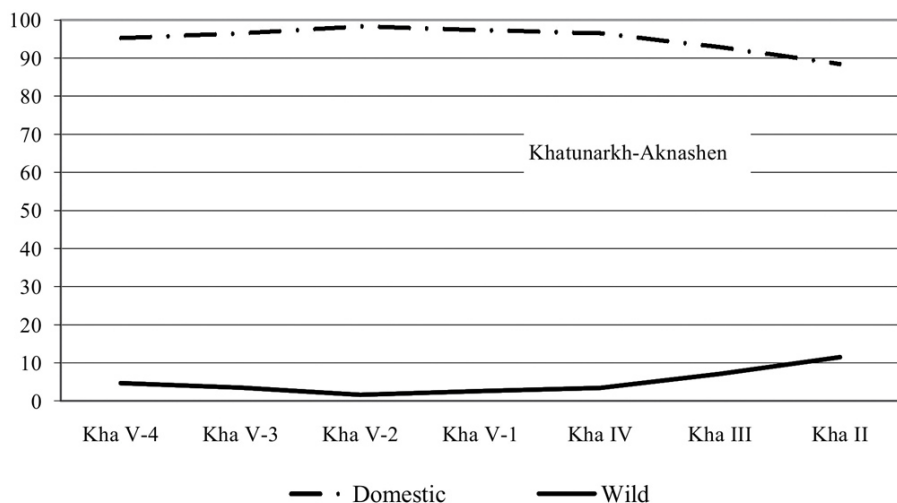


Fig. 8.16. Diagram of the ratio of domestic animals to wild animals at Khatunarkh-Aknashen and Aratashen between the earliest horizons (Kha V–IV and Ara II) and the latest horizons (Kha III–II and Ara I) of the two sites (% NR).

There is very little evidence for hunting birds or for fishing. The fish remains found on the two sites belong to local freshwater species: carp (*Cyprinus carpio*), tench (*Tinca tinca*) and catfish (*Silurus glanis*). Thus far the sizes of the individuals fished are medium and large. For example in the case of the catfish, its size corresponds to 1.5 m for a weight of 30 kg. These dimensions are not particularly characteristic of all the fish caught, as most of the material currently studied comes from samples taken directly by eye and by hand. No fish remains have been recovered through the sieving of sediments.

Herding and exploitation of Caprinae

The animal economy of Khatunarkh-Aknashen and Aratashen was based upon the herding of sheep and goats, sheep being predominant during the entire duration of the occupations. Thus a study of age at slaughtering was carried out first of all to analyse the types of exploitation of the Caprinae. Age profiles of sheep and goats together were established to define the main orientations of the breeding strategies, with the knowledge that goats are less frequent on both sites.

Age at slaughter profiles in the early horizons (Ara and Kha V–IV)

At Aratashen, the age profiles reveal in the early sub-phases of horizon Ara II a preferential slaughter of class D (1–2 years), characteristic of meat production (Fig. 8.20). It is the age when sheep and goats reach their maximal size for a maximal weight. We consider, according to traditional herding practices of today, that it is especially the young males that are sacrificed at this age (cf. Helmer *et al.* 2007). The presence of juvenile animals (class B, 2–6 months) is constant even though the numbers are low. Although in the earliest sub-phases Ara IId and IId/IIC, the very young animals of class A (0–2 months) are absent, they are represented later beginning with Ara IIC. We also observe a kill-off of sub-adult and adult animals (class EF, 2–4 years, even G, 4–6 years) in all the sub-phases on this site. Class HI, which includes animals older than six years, old breeding animals and producers of milk and wool, is also represented in all the sub-phases.

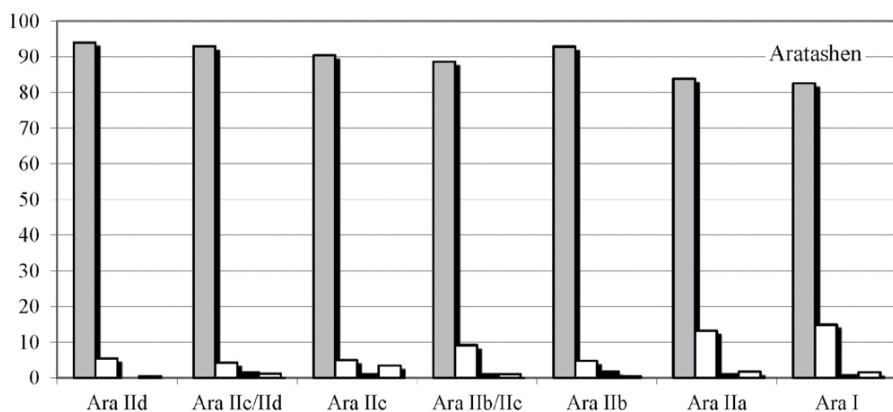
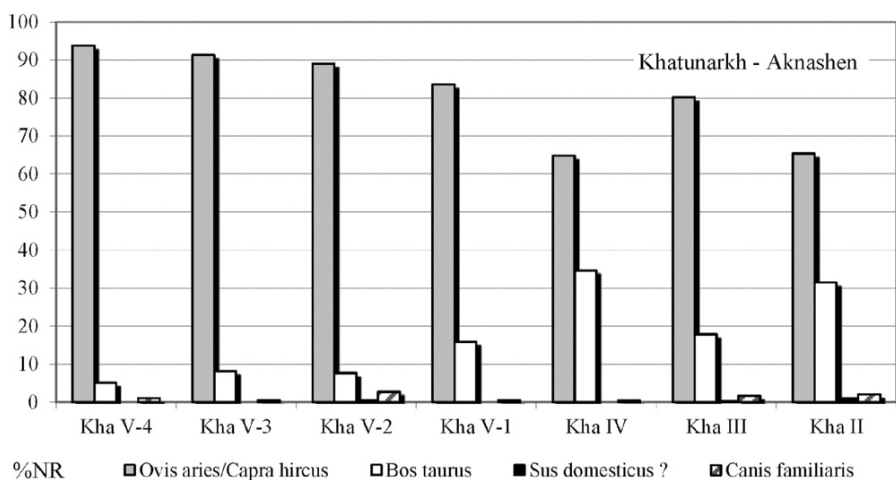


Fig. 8.17. Histogram of the frequency of domestic species at Khatunarkh-Aknashen and Aratashen by sub-phases (Kha V-4–IV contemporary to Ara IId–IIa; Kha III–II contemporary to Ara I).

On the other hand at Khatunarkh-Aknashen, in the early sub-phases Kha V–IV, the kill-off peak is found in the animals of class C (6–12 months), thus younger than at Aratashen. The very young animals and juveniles of classes A and B are absent, except for Kha V-4 (class A represented) and Kha V-2 (class B represented). However, the occurrence among the post-cranial bones of remains attributable to juvenile animals must be noted. Class HI of animals older than six years is practically absent. Thus the age profiles are very different between the two sites.

Age at slaughter profiles in the late horizons (Ara I and Kha III–II)
The age profiles for the latest horizons of the two sites show no major

changes in comparison to the preceding horizons and present the same characteristics (Fig. 8.21). Ara I: presence of classes A and B of very young animals and juveniles, high slaughter rate for classes C, D, and EF. Kha III–II: absence of very young animals and juveniles, that is, no representation for classes A and B, and a very clear kill-off peak for class C (6–12 months) in Kha III.

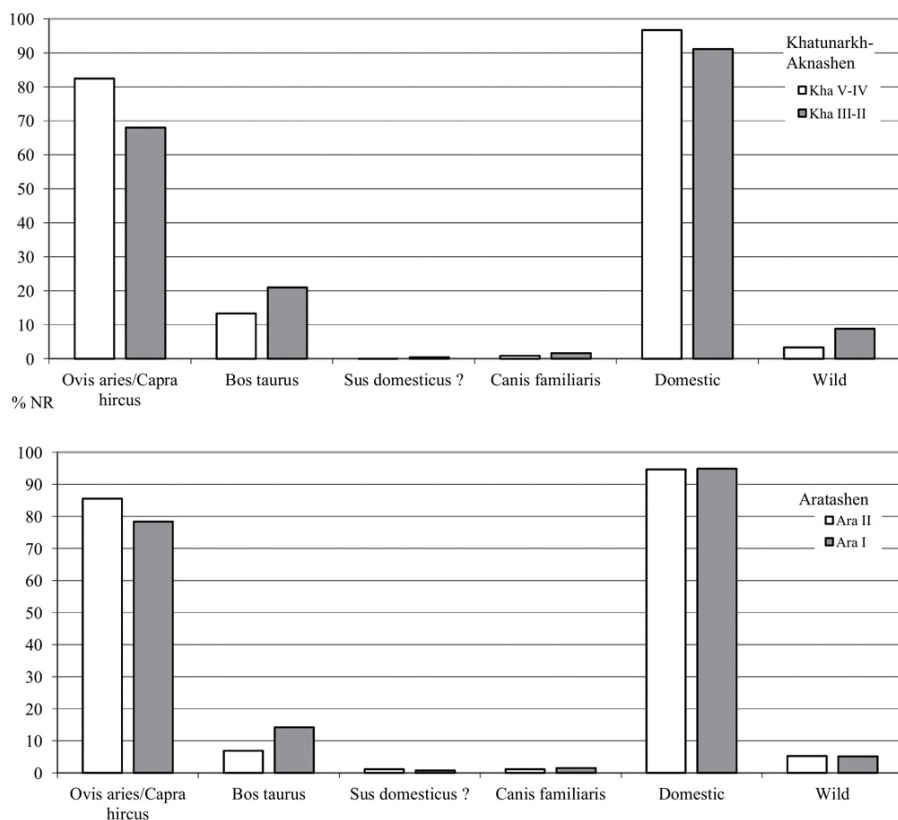


Fig. 8.18. Histogram of the frequency of domestic species and ratio of domestic animals to wild animals at Khatunarkh-Aknashen and Aratashen between the earliest horizons (Kha V–IV and Ara II) and the latest horizons (Kha III–II and Ara I) of the two sites.

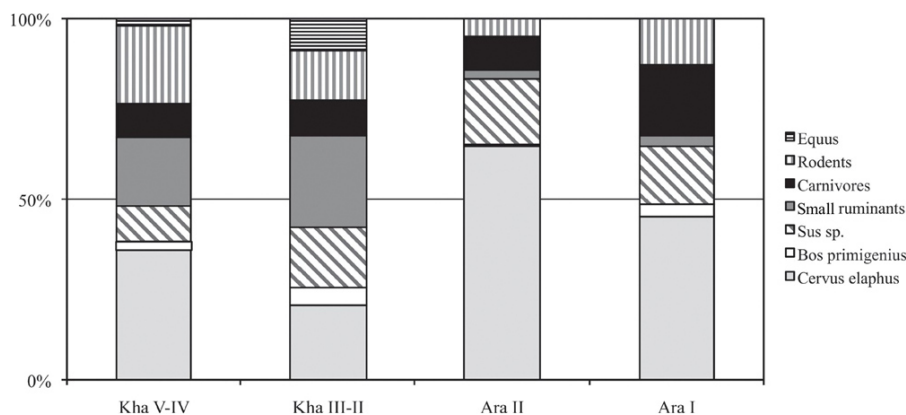


Fig. 8.19. Histogram of the proportions of wild fauna (out of 100%: NR Kha V–IV=197; NR Kha III–II=272; NR Ara II=343; NR Ara I=39; Rodents: hare and beaver; Carnivores: foxes, mustelids, wolf, cat, bear, small undetermined carnivores; Small ruminants: mouflon, wild goat, gazelle, roe deer; Sus: all suids).

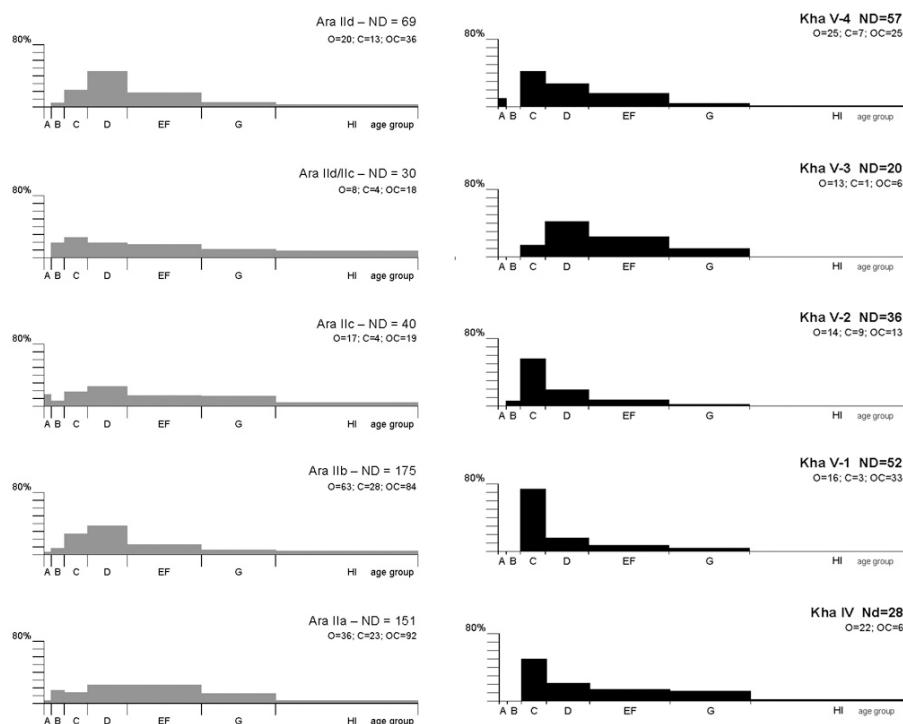


Fig. 8.20. Age at slaughter profiles of sheep and goats together, in the early horizons (Ara II and Kha V–IV). ND=number of teeth; O=Ovis aries; C=Capra hircus; OC=Ovis/Capra (class A: $\pm 0-2$ months; class B: $\pm 2-6$ months; class C: $\pm 6-12$ months; class D: $\pm 1-2$ years; class EF: $\pm 2-4$ years; class G: $\pm 4-6$ years; class HI: ± 6 years and older).

years; class G: $\pm 4-6$ years; class HI: > 6 years).

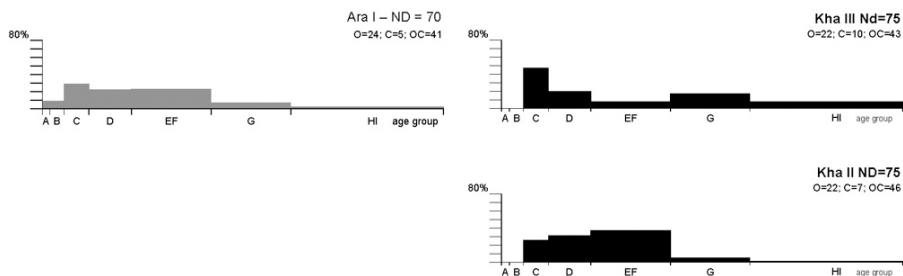


Fig. 8.21. Age at slaughter profiles of sheep and goats together, in the late levels (Ara I and Kha III-II). ND=number of teeth; O=Ovis aries; C=Capra hircus; OC=Ovis/Capra (class A: $\pm 0-2$ months; class B: $\pm 2-6$ months; class C: $\pm 6-12$ months; class D: $\pm 1-2$ years; class EF: $\pm 2-4$ years; class G: $\pm 4-6$ years; class HI: > 6 years).

The mode of Caprinae exploitation on each site

The analyses of the ages at slaughter reveal on the one hand the differences in the mode of exploitation of the Caprinae between the two sites, and on the other hand the persistence of these modes of exploitation and their differences over time: absence of juveniles of less than 6 months at Khatunarkh-Aknashen versus presence of juveniles and groups of adults and older animals at Aratashen. Kill-off appears to target class C at Khatunarkh-Aknashen versus kill-off spread through all age classes at Aratashen.

At Khatunarkh-Aknashen, the profiles suggest consumption of the tender meat of young animals. At Aratashen, the more varied profiles of ages at slaughter suggest a more complex exploitation of the animals as the age classes absent at Khatunarkh-Aknashen are present at Aratashen: the juveniles (classes A and B) and the older breeding animals (class HI). All the age categories of a herd appear at Aratashen and thus all the stages of exploitation of the animals. This is not the case for the horizons of contemporary occupations at Khatunarkh-Aknashen. A certain number of questions are to be asked in view of these differences. Are they due to a difference of function between the two sites? Should they be interpreted in terms of a difference in the status of the occupants of the sites or rather in terms of seasonality or at least periodicity of occupation? Could Aratashen have been, unlike Khatunarkh-Aknashen, occupied year-round, as suggested by the presence of very young and very old individuals? The presence of very young animals and juveniles suggests that lambing took place on the site of Aratashen. To attempt answers to these

questions, isotopic analyses as well as studies of seasonality based on teeth will be carried out.

Conclusions

The study of the faunal remains of Khatunarkh-Aknashen and Aratashen gives a first insight into the biodiversity during the 6th millennium BC, the animal economy and the practices of hunting and herding of Neolithic societies in Armenia.

The comparison between these two sites, occupied during the same periods of the Neolithic, shows that they share a large number of similarities in the exploitation of animals. Both had an animal economy based on herding with a predominance of Caprinae (especially sheep), exploited for their meat. At the end of occupation, on both sites, we observe the same change in the orientations of herding with an increase in the exploitation of cattle. Also on both sites, hunting does not appear to have had an important function in the food economy. Other activities such as fishing and hunting of birds have left only a little evidence. For the moment, the low number of remains studied limits interpretation concerning their development during the Neolithic. However, the frequencies although low of wild species are evidence of an exploitation of the plain with its fluvial network (beaver, fish) and the more distant mountains (wild goats) as well as the coexistence of forested and wooded zones (red deer, roe deer, wild boar, bear, wild cat) with less wooded and probably drier zones (gazelles). The sites also possess their own particularities. The choice of game appears to be specific to each site. The great diversity of prey observed at Khatunarkh-Aknashen is not so clear at Aratashen, where the hunting of red deer, along with the gathering of antlers, played a major role and represents a source of acquisition, among others, of raw materials, antlers, for the bone industry. At Khatunarkh-Aknashen, the appearance of horses in the late levels also marks an important difference between the two sites.

The age profiles of the Caprinae that constituted the base of the animal economy also illustrate differences whose interpretation is essential for comprehension of the occupation of these two sites, and are probably evidence of their relationship and their function, linked to their geographical proximity. These different but almost complementary exploitations raise the question of rhythms of occupation. We may ask whether we are observing the effects of a system of herding with a sharing of the herd (females and juveniles on one side, young adults and adults on the other) which would correspond to a system of division of tasks.

The excavations at Khatunarkh-Aknashen have not been completed, and the faunal remains being analysed or to be recovered will add to the present data. The continuation of the study will certainly provide more elements that will confirm or invalidate these initial results and will contribute above all to the interpretation of the occupation of this site.

The comparative analysis of the archaeozoological data from these two sites will continue. The morphometric study of the cattle and the sheep will enable characterisation of these two taxa, which are absolutely unknown in this region for the Neolithic period, and comparison with the cattle and sheep of the nearest Neolithic sites for which there are published archaeozoological analyses (for ex. Turkey; Iran, Georgia). It is to be noted that the quite abundant material from these two sites, studied with similar methods and with shared data and effective collaboration, enables a particularly interesting archaeozoological investigation as it is a pioneering one in this zone and for this period.

Acknowledgements

The members of the 'Caucasus' archaeological mission and the Institute of Archaeology and Ethnography of Yerevan thank the French Ministry of Foreign and European Affairs and the National Academy of Sciences of Armenia, which provided financial backing for their work in Aratashen and Khatunarkh-Aknashen.

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Notes

1 The horizons at Khatunarkh-Aknashen are referred to as Kha II to Kha V in the text, tables and figures, while the horizons at Aratashen are referred to as Ara I and Ara II, in order to avoid confusion between the names of the sites, which are quite similar phonetically, and to simplify the reading of the figures.

2 Fragmentary remains of canids have been attributed according to their robustness to the wolf, nevertheless the variety of types of dog in the Armenian Neolithic and the variability covered by the dimensions of their bones are unknown and these determinations are preliminary suppositions.

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9. Animal bones from Aramus, Armenia, excavation 2004

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Lilit Mirzoyan*

In this site report a small assemblage from the initial excavation campaign at the 1st century BC Urartian fortress of Aramus near Yerevan in Armenia is presented. The material consists mainly of domestic livestock (sheep/goat, cattle and pig) plus minor numbers of dog, horse, donkey, fox, hare, rodents, birds, amphibians and fish. Three settlement periods could be discriminated archaeologically, which differ in their species frequencies and other criteria. An interesting feature is the occurrence of several songbird bones in period I. Skeletal element distributions, age and sex profiles, osteometrical and taphonomic data are provided by period.

Keywords Iron Age, Urartu, livestock, songbirds

Introduction

After a preliminary survey in autumn 2003 the site of Aramus, county Kotayk, Armenia ([Fig. 9.1](#)) was chosen for an archaeological joint venture project between the University of Innsbruck, Austria and the Yerevan State University, Armenia.¹ The project was planned for a 5-year period. The first campaign was carried out in September 2004, subsequent campaigns in 2005–2008. This is a preliminary report covering the material found in 2004.² The complete report covering the whole material of 2004–2008 will be included in the excavation monograph to be published by the University of Innsbruck.

The excavation site is a prehistoric fortress situated on a hilltop 1500 m above sea level, ca. 20km northeast of Yerevan ([Fig. 9.1](#)) and a few hundred metres southwest of the present village of Aramus. The architecture of the fortress, pottery and metal artefacts found within

the site assign the settlement to the period of the kingdom of Urartu (8th–7th century BC). A cuneiform inscription found in 1960 nearby points to a possible connection between the site and the city of Darani conquered by the Urartian king Argishti I in the 8th century BC (Avetisyan 2001, 44–46; Bauer-Manndorf 1984, 119). One major aim of the current project is to shed light on the development and decline of the kingdom of Urartu in relation to the preceding and subsequent social and political structures in the region.

In the planning of the Aramus project environmental archaeology was seen as an important part of the research. The authors took part in the first campaign to assess the potential of specific environmental archaeological methods to produce evidence at the Aramus site. During excavation it became soon obvious that the preservation conditions for organic material in the fine clay soil were excellent. Due to limited resources of time and manpower, efforts in environmental archaeology concentrated on human remains, plant macrofossils and animal bones. This paper will reveal the information retrieved from the animal bones.

Previous archaeological work at the site of Aramus was undertaken by Vanzandyan in 1966 and by Avetisyan in 1988 (Khanzadian 1979, 11; Avetisyan 2001, 37). While no archaeozoological data are available from the first excavation, Avetisyan reports ‘fragments of large and small horned animals’ from the rooms 1 and 3–7 in the 1988 excavated area. The find of the ‘whole skull of a bull’ in room 5 is emphasised (Avetisyan 2001, 39–43). Provided the analyst was familiar with the zoological terminology, this information can be considered as the presence of species of the family Bovidae (cattle, sheep, goat, gazelle). In room 6 ‘a great number of charred animal bones’ was recovered. Additionally one ‘button from bone’ is mentioned from room 7 (Avetisyan 2001, 42–43, 50).

The Caucasus and Central Asia





Fig. 9.1. Maps of site location.

Material and methods

During the 2004 excavation campaign 2002 bone fragments were recovered. On site the finds were carefully cleaned with cold water and brushes, then dried, bagged and labelled stratigraphically separated. Matching fragments were glued together with white carpenter glue (Uhu Holz-Expressleim, Bindan-P Propellerleim). This reduced the number of bones to a total of 1860. Each bone was labelled with black ink with a code consisting of site-shortcut (AR), year (04), stratigraphic unit and bone number (e.g. AR04/ d021/654). The bulk of the material (n=1645) was sampled by hand collection. Great accuracy can be attested to the students and volunteers, since even bones of very small species were found, which is unusual for hand-collected assemblages. An additional amount of 215 very small fragments were extracted from two wet sieved samples from stratigraphic unit d 011 (total volume 20 litres).

The bones were identified by the authors using the reference collections of the Institute of Zoology, Armenian National Academy of Sciences (ANAS), Yerevan, Armenia, the Institute of Anatomy, University of Veterinary Medicine Vienna, Austria and the Archäologisch-Zoologische Arbeitsgruppe Schleswig (AZA), Zentrum für Baltische und Skandinavische Archäologie (ZBSA), Archäologisches Landesmuseum Schleswig-Holstein, Schleswig, Germany with support of Gerhard Forstenpointner and Alfred Galik. Rodents were additionally checked against specimens from the skeletal collection of the Natural History Museum Vienna (NMW).³ Fish bones were

determined by Alfred Galik. In addition to reference material, identification criteria were employed from the publications of Boessneck *et al.* (1964), Brohmer (1984), Cohen and Serjeantson (1996), Engelmann *et al.* (1986, 124–134), Prummel and Frisch (1986), Schmid (1972) and Spitzenberger (2001). Each specimen was monitored for a set of archaeozoological data (skeletal element, body side, species, age, sex, pathology, anatomic measurements) and taphonomic features (tool marks, traces of fire, animal gnawing, weathering, trampling, root etching). Measurements were taken with callipers according to von den Driesch (1976; 1999). Data about geographical distribution of species was obtained from Adamian and Klem (1997), Dal (1954), Engelmann *et al.* (1985), Gepner and Naumov (1972), Heinzel *et al.* (1972) and Oganessyan (pers. comm. 7–10/2005). Applied geographic distribution data relies on the assumption that species distribution has not changed substantially since the time of the site inhabitation. Domestic species were named after the recent ruling of the International Commission on Zoological Nomenclature (ICZN) (Gentry *et al.* 2004). The analysed material is stored at the Institute of Zoology, ANAS, Yerevan, under the supervision of Nina Manaseryan, except for two human bones (nos 122, 435) belonging to the skeleton from grave 1, which is stored at the History Museum of Yerevan⁴ under the supervision of Armine Sargsian.

The bone finds were excavated from two different areas within the site, from the eastern part of the acropolis (area A, n=1585, Fig. 9.2) and the western part of the acropolis (area B, n=275). Area A is a rectangular shaped ditch measuring 41.5 × 5.3m, area B traced the outline of the rooms 5 and 6 of the 1988 excavation.

The volumes of soil of each period moved were different, causing a bias in comparability. Chronological and cultural data from specific layers was not available at the time of writing. Instead a relative chronology according to the stratigraphy of the site was used, which resulted in a grouping of the finds from area A into three distinguishable periods (Table 9.1). Period I can be regarded as topsoil. It contained multi-period remains and could not be related to building structures in 2004. Layers d 011, d 012 and d 021 in period II are cultural layers covered by rubble. Period III comprises mainly building and rubble layers. The bones from area B were not stratigraphically separated during excavation and thus cannot be attributed to a specific cultural or time period.

Table 9.1. Chronological grouping of animal bone finds from Aramus,

<i>Period</i>	<i>Phase</i>	<i>Stratigraphic units</i>	<i>Vol. soil¹ (m³)</i>	<i>No. bones</i>
		surface layer		110
I	a–b	s 002, d 002, d 003, d 005, d 007, d 022, grave 1	10	525
II	c	s 006, d 011, d 012, d 018, d 021	21	740
III	e–f	d 009, d 013, d 014, d 019, d 023	6	148

not yet assigned: d 004 (2 bones), d 016 (51 bones) and Locus DOST IV (9 bones)

1 = approximate values

Results

Before presenting the archaeozoological data, it has to be noted that six human bones were found mixed within the animal remains. These include a processus coroneus of a left mandibula (grave1,435), a 1st toe joint of a 2nd toe (phalanx 1 • II posterior, s002/122), a fragment of a left radius (d003/404), a left 5th metatarsus (d012/528), a left 3rd metacarpus (d016/857) and a pelvis fragment (d021/709). The processus coroneus matches with the mandibula of the female skeleton from grave 1. The toe joints of the skeleton are missing and since bone no. 122 was found in the vicinity of the grave and its age status fits to that of the skeleton, this phalanx derives almost certainly from the same individual. This does not however hold true for the remaining four human bones. Metatarsus no. 528 belongs to a juvenile individual less than 19 years old. Being younger than the buried woman, it cannot be attributed to grave 1. Bones no. 404, 709 and 857 cannot belong to the skeleton either, as they occur twice (Gantner pers. comm. 12-2004–1-2005). This proves that at least two individuals are extant. If the contextual information is taken into account, revealing that fragment 528 and 709 are from period II, while fragment 404 is from period I, the minimum number of human individuals evident is three.

Turning to the animal bones, an overview shows that all vertebrate classes (fish, amphibians, birds, mammals) are represented except reptiles. In total 867 bones (46.7%) could be identified at least to order level (=NISP). [Table 9.2](#) presents the species representation of the whole assemblage and the distribution over the chronological periods; [Table 9.3–9.5](#) show the details for the sub-samples of periods I–III. Not unexpected for a fortified settlement comes the result that domestic mammals comprise the overwhelming part of the bone assemblage.

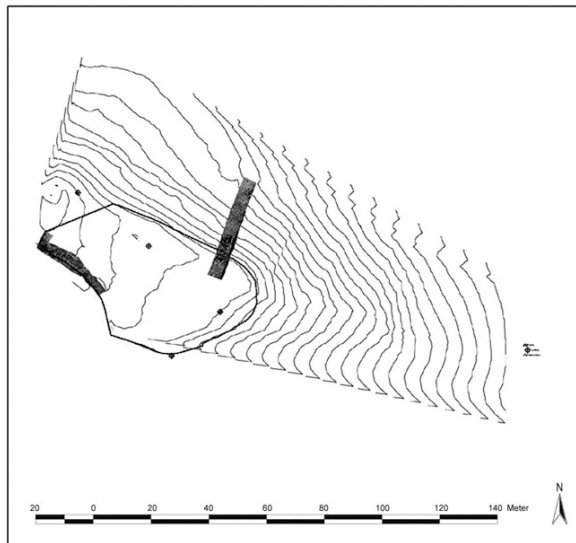


Fig. 9.2. Site map of Aramus, excavation 2004; area A marked.

Table 9.2. Species representation of animal bones from Aramus, Armenia, excavation 2004, area A & B.

Species		No. bones					area B room 5 + 6	Total
		area A						
		surface layer d 001	period I	period II	period III	not assigned features ¹		
<i>domestic mammals</i>	<i>Mammalia</i>							
cattle	<i>Bos taurus</i>	8	53	79	19	8	17	184
domestic sheep	<i>Ovis aries</i>	7	22	6	4	–	1	40
domestic goat	<i>Capra hircus</i>	–	4	5	4	–	1	14
sheep / goat	<i>Ovis / Capra</i>	25	76	55	27	7	37	227
domestic pig	<i>Sus domesticus</i>	11	50	26	3	2	7	99
domestic horse	<i>Equus caballus</i>	–	–	3	1	–	–	4
donkey	<i>Equus asinus</i>	–	–	1	–	–	–	1
dog	<i>Canis familiaris</i>	–	1	1	2	2	2	8
total domestic mammals		51	206	176	60	19	65	577
<i>wild mammals</i>	<i>Mammalia</i>							
red fox	<i>Vulpes vulpes</i>	–	2	–	–	–	3	5
hare	<i>Lepus europaeus</i>	–	1	–	1	–	6	8
family rats and mice	Muridae	–	–	–	1	–	–	1
Persian jird, gerbil	<i>Meriones persicus</i>	–	4	169	–	–	–	173
golden hamster	<i>Cricetus auratus</i>	–	1	2	3	–	–	6
jerboa	<i>Allactaga williamsii</i>	–	4	–	–	–	–	4
common vole	<i>Microtus arvalis</i>	–	2	–	–	–	–	2
order rodents	Rodentia indet.	–	4	32	–	–	19	55
total wild mammals		–	18	203	5	–	28	254
<i>man</i>	<i>Homo sapiens</i>	–	3	2	–	1	–	6
total identified mammals	<i>Mammalia</i>	51	227	381	65	20	93	837
unidentified mammals	<i>Mammalia indet.</i>	57	280	151	79	41	179	787
total mammals	total <i>Mammalia</i>	108	507	532	144	61	272	1624
<i>birds</i>	<i>Aves</i>							
domestic cock	<i>Gallus gallus</i>	–	1	–	–	–	–	1
family pheasants and fowl	Phasianidae	1	5	–	–	–	–	6
gadwall	<i>Anas strepera</i>	–	–	–	–	–	1	1
carion crow	<i>Corvus corone</i>	–	–	–	2	–	–	2
black-billed magpie	<i>Pica pica</i>	–	1	–	–	–	–	1
common starling	<i>Sturnus vulgaris</i>	–	7	–	–	1	1	9
house sparrow	<i>Passer domesticus</i>	–	–	–	–	–	1	1
order singing birds	Passeriformes	–	3	–	–	–	–	3
unidentified birds	<i>Aves indet.</i>	1	1	–	1	–	–	3
total birds	total <i>Aves</i>	2	18	–	3	1	3	27
<i>amphibians</i>	<i>Amphibia</i>							
genus toads	<i>Bufo</i> sp.	–	–	–	1	–	–	1
true frog	<i>Rana macromnemis camerani</i>	–	–	1	–	–	–	1
total amphibians	total <i>Amphibia</i>	–	–	1	1	–	–	2
<i>fish</i>	<i>Pisces</i>							
family salmones and trouts	Salmonidae	–	–	1	–	–	–	1
family minnows	Cyprinidae	–	–	3	–	–	–	3
family perches	Percidae	–	–	2	–	–	–	2
unidentified fish	<i>Pisces indet.</i>	–	–	19	–	–	–	19
total fish	total <i>Pisces</i>	–	–	25	–	–	–	25
unidentified vertebrates	<i>Vertebrata indet.</i>	–	–	182	–	–	–	182
NISP		52	244	387	67	21	96	867
total bones		110	525	740	148	62	275	1860

Wild mammals are on second rank, but like all other vertebrates, are represented only by singular bones. The number of bones of each period ranging from 740 to 148 is too low for a reasonable comparative statistical analysis. Therefore it has to be kept in mind that all results concerning species, skeletal element or age distribution are highly susceptible to random bias and have to be valued as tendencies only.

Table 9.3. Species representation of animal bones from Aramus, Armenia, excavation 2004, area A, Period I, phase a–b, stratigraphic units s 002, d 002, d 003, d 005, d 007, grave 1.

<i>Species</i>		<i>No. bones</i>	<i>Relative amount of no. bones%</i>	<i>of NISP¹ %</i>	<i>Min. no. individuals² (MNI)</i>	<i>Bone weight g</i>	<i>Relative weight of no. bones %</i>	<i>of NISP¹ %</i>
<i>domestic mammals</i>	<i>Mammalia</i>							
cattle	<i>Bos taurus</i>	53	10.1	21.7	2	1 122.5	42.7	57.5
domestic sheep	<i>Ovis aries</i>	22	4.2	9.0	2	142.0	5.4	7.3
domestic goat	<i>Capra hircus</i>	4	0.8	1.6	1	40.5	1.5	2.1
sheep / goat	<i>Ovis / Capra</i>	76	14.5	31.1	2	318.0	12.1	16.3
domestic pig	<i>Sus domesticus</i>	50	9.5	20.5	3	292.5	11.1	15.0
dog	<i>Canis familiaris</i>	1	0.2	0.4	1	0.5	0.02	0.03
total domestic mammals		206	39.2	84.4	11	1916.0	72.9	98.2
<i>wild mammals</i>	<i>Mammalia</i>							
red fox	<i>Vulpes vulpes</i>	2	0.4	0.8	1	1.5	0.06	0.08
hare	<i>Lepus europaeus</i>	1	0.2	0.4	1	1.5	0.06	0.08
Persian jird, gerbil	<i>Meriones persicus</i>	4	0.8	1.6	2			
golden hamster	<i>Cricetus auratus</i>	1	0.2	0.4	1			
jerboa	<i>Allactaga williamsii</i>	4	0.8	1.6	1	2.5	0.1	0.1
common vole	<i>Microtus arvalis</i>	2	0.4	0.8	1			
order rodents	Rodentia indet.	4	0.8	1.6	—	1.0	0.04	0.05
total wild mammals		18	3.4	7.4	7	6.5	0.2	0.3
<i>man</i>	<i>Homo sapiens</i>	3	0.6	1.2	2	14.5	0.6	0.7
total identified mammals	<i>Mammalia</i>	227	43.2	93.0	21	1937.0	73.7	99.3
unidentified mammals	<i>Mammalia indet.</i>	280	53.3	—	—	678.5	25.8	—
total mammals	total <i>Mammalia</i>	507	96.6	93.0	21	2615.5	99.5	99.3
<i>birds</i>	<i>Aves</i>							
domestic cock	<i>Gallus gallus</i>	1	0.2	0.4	1	7.0	0.3	0.4
family pheasants & fowl	Phasianidae	5	1.0	2.0	1	5.5	0.2	0.3
black-billed magpie	<i>Pica pica</i>	1	0.2	0.4	1	0.5		
common starling	<i>Sturnus vulgaris</i>	7	1.3	2.9	1	0.5	0.02	0.03
singing birds	Passeriformes.	3	0.6	1.2	—	0.3	0.01	0.02
unidentified birds	<i>Aves indet.</i>	1	0.2	—	—	0.2	0.01	—
total birds	total <i>Aves</i>	18	3.4	7.0	4	14.0	0.5	0.7
NISP ¹		244	46.5	100.0	25	1950.8	74.2	100.0
total bones		525	100.0		25	2629.5	100.0	

- 1: NISP = number of identified specimen = total bones exclusive *Mammalia indet.*, *Aves indet.*
- 2: MNI greater than 1 are evident by the following skeletal elements: 2 individuals of *Bos* by 2 left metacarpi (proximal end); 2 individuals of *Ovis* by 2 left ulnae (proximal end); 2 individuals of *Ovis/Capra* by 2 right mandibulae (facies articularis), 2 right metacarpi (proximal end), 2 left femora (distal end) and 2 right metatarsi (proximal end); 3 individuals of *Sus* by 3 left humeri (proximal end); 2 individuals of *Meriones* by 2 left pelves.

Anatomical measurements could be taken from 136 bones, but only 72 were completely preserved, allowing the whole set of measurements to be taken (Table 9.6). Of the measurable bones, 26 are from species for which not enough comparative data were available to draw further conclusions (bones of 6 hares, 18 birds, 2 rodents). The majority of the remaining domestic mammal bones (n=104) are compact bones of the foot-joints (autopodium, n=73) or vertebrae (n=7), for which no analytical data exist about a direct relation between bone and body size. Consequently the database for a metrical analysis is very small and does not allow a general picture about size, stature or other phenotypical data of the domestic animals bred. Only three bones provided criteria for morphological sexing.

Period I

Species and skeletal element representation

Out of a total of 525 bones from period I approximately half (n=244; 46.5%) could be identified to order level or higher (Table 9.3).

Period I includes the highest amount of domestic mammals (n=206) with sheep and goat (*Ovis/Capra*) ranking first (n=104), followed by cattle (*Bos taurus*, n=53) and pig (*Sus domesticus*, n=50) in equal parts. Judged by the bone weight, cattle is the most important species followed by sheep, goat and pig. In layer d 002 one toe joint (phalanx 1) of a dog (*Canis familiaris*) was found. Of the 18 wild mammal bones 15 were of rodents, none of which can be attributed with certainty to period I as the animals may be intrusive. Four of the rodent bones belong to gerbils (sub-family Gerbillinae), most probably to the species Persian jird (*Meriones persicus*, Fig. 9.3).⁵

Table 9.4. Species representation of animal bones from Aramus, Armenia, excavation 2004, area A, Period II, phase c, stratigraphic units s 006, d 001, d 012, d 018, d 021.

Species		No. bones	Relative amount of no. of NISP ¹ bones %		Min. no. individual s ² (MNI)	Bone weight g	Relative weight of no. of NISP ¹ bones %	
domestic mammals	Mammalia							
Cattle	<i>Bos Taurus</i>	79	10.7	20.4	2	1737.5	68.1	71.0
domestic sheep	<i>Ovis aries</i>	6	0.8	1.6	1	25.0	1.0	1.0
domestic goat	<i>Capra hircus</i>	5	0.7	1.3	1	35.0	1.4	1.4
sheep / goat	<i>Ovis / Capra</i>	55	7.4	14.2	3	345.5	13.5	14.1
domestic pig	<i>Sus domesticus</i>	26	3.5	6.7	2	244.5	9.6	10.0
domestic horse	<i>Equus caballus</i>	3	0.4	0.8	1	36.5	1.4	1.5
Donkey	<i>Equus asinus</i>	1	0.1	0.3	1	1.5	0.1	0.1
Dog	<i>Canis familiaris</i>	1	0.1	0.3	1	6.5	0.3	0.3
total domestic mammals		176	23.8	45.5	12	2431.5	95.4	99.3
wild mammals	Mammalia							
Persian jird, gerbil	<i>Meriones persicus</i>	169	22.8	43.7	3	7.0	0.3	0.3
golden hamster	<i>Cricetus auratus</i>	2	0.3	0.5	1	0.0 ³	—	—
order rodents	Rodentia indet.	32	4.3	8.3	—	1.0	0.04	0.04
total wild mammals		203	27.4	52.5	4	8.0	0.3	0.3
Man	<i>Homo sapiens</i>	2	0.3	0.5	1	8.0	0.3	0.3
total identified mammals	Mammalia	381	51.5	98.4	17	2447.5	96.0	100.0
unidentified mammals	Mammalia indet.	151	20.4	—	—	96.0	3.8	—
total mammals	total Mammalia	532	71.9	98.4	17	2543.5	99.7	100.0
Amphibians	Amphibia							
true frog	<i>Rana macrocnemis camerani</i>	1	0.1	—	1	0.0 ³	—	—
total amphibians	total Amphibia	1	0.1	—	1	0.0 ³	—	—
Fish	Pisces							
family salmones and trouts	Salmonidae	1	0.1	0.3	1	0.0 ³	—	—
family minnows	Cyprinidae	3	0.4	0.8	1	0.0 ³	—	—
family perches	Percidae	2	0.3	0.5	1	0.0 ³	—	—
unidentified fish	Pisces indet.	19	2.6	—	—	0.0 ³	—	—
total fish	total Pisces	25	3.4	1.3	3	0.0 ³	—	—
unidentified vertebrates ⁴	Vertebrata indet.	182	24.6	—	—	6.5	0.3	—
NISP ¹		387	52.3	100.0	21	2447.5	96.0	100.0
total bones		740	100.0		21	2550.0	100.0	

1: NISP = number of identified specimen = total bones exclusive Mammalia indet., Pisces indet., Vertebrata indet.
2: MNI greater than 1 are evident by the following skeletal elements: 2 individuals of *Bos* by 2 right humeri (distal end); 3 individuals of *Ovis/Capra* by 3 left 3rd mandibular molars (M 3) and 3 left humeri (distal end); 2 individuals of *Sus* by 2 left 4th mandibular milk premolars (Pd 4 mandibular); 3 individuals of *Meriones persicus* by 3 crania (incisivum + nasale), 3 right tibiae and 3 left calcanei.
3: less than 0.5 g = below scale limit.

4: very small bone fragments from wet sieved samples 1 + 2; mainly mammals.

Four hind limb elements belong to jerboas (family Dipodidae). Ecologic habitat needs and geographic distribution restricts these to the species *Allactaga williamsii* (Dal 1954, 162–163; Oganessyan, pers. comm. 7-10-2005). A cranium and a mandibula belong to a vole (genus *Microtus*). Since all other species of the genus *Microtus* can be ruled out for morphologic or geographic distribution reasons this belongs almost certainly to the common vole (*Microtus arvalis*) (Dal 1954, 169–172; Oganessyan, pers. comm. 7-2005; 10-2005). Another skull is from a golden hamster (*Cricetus auratus*). The remaining three wild mammal bones include a cranium fragment (frontale) and a tooth of a red fox (*Vulpes vulpes*) and an ulna of a hare (*Lepus europaeus*). As several obviously inhabited fox dens could be observed at the site, it cannot be excluded with certainty that these fox bones are modern intrusions too. The hare bone showed carnivore bite marks and therefore it is possible that it was part of a modern fox meal instead of an Urtartian dish. Assumed that the fox and hare bones are contemporary with the archaeological layer, this would result in a domestic to wild mammal ratio of 69:1 (excluding rodents).

A comparatively high number of bird bones (n=18) was retrieved from period I layers. Six of these are from members of the family Phasianidae (pheasants and fowl). One pelvis fragment (grave1/448) belongs to a domestic cock (*Gallus gallus*), three others (d002/377/381/384) are either Caucasian black grouse (*Tetrao mlokosiewiczzi*) or domestic cock. The remaining birds (n=10) belong to the order singing birds (Passeriformes). Seven of them could be identified as common starling (*Sturnus vulgaris*, Fig. 9.4). The fact that nearly all singing bird bones were from period I layers evokes the question, if they did have a special significance in that phase? Have they been selectively harvested or is this just a random bias? Another possible scenario may arise out of the fact that starlings are nesting in cavities of cliffs or buildings (Adamian & Klem 1997, 136; Aghababyan, pers. comm. 10-2005). They might have used the clay brick walls of the fortress (ruins) for accommodation.



Fig. 9.3. Persian jird (*Meriones persicus*). a) skull (d012/69) from Aramus (Photo: Scheffka); b) habitus (Photo: Rudloff, from Grimmberger et al. 2009, 169).

Table 9.5. Species representation of animal bones from Aramus, Armenia, excavation 2004, area A, Period III, phase e–f, stratigraphic units d 009, d 013, d 011, d 019, d 023.

Species		No. bones	Relative amount of no. bones %	Relative amount of NISP ¹ %	Min. no. individuals ² (MNI)	Bone weight g	Relative weight of no. bones %	Relative weight of NISP ¹ %
<i>domestic mammals</i>	<i>Mammalia</i>							
cattle	<i>Bos taurus</i>	19	12.8	28.4	1	252.0	52.4	54.3
domestic sheep	<i>Ovis aries</i>	4	2.7	5.8	1	24.0	5.0	5.2
domestic goat	<i>Capra hircus</i>	4	2.7	5.8	1	9.0	1.9	1.9
sheep / goat	<i>Ovis / Capra</i>	27	18.2	40.3	2	104.5	21.7	22.5
domestic pig	<i>Sus domesticus</i>	3	2.0	4.5	1	52.5	10.9	11.3
domestic horse	<i>Equus caballus</i>	1	0.7	1.5	1	15.5	3.2	3.3
dog	<i>Canis familiaris</i>	2	1.4	3.0	1	3.0	0.6	0.6
total domestic mammals		60	40.5	89.6	8	460.5	95.7	99.2
<i>wild mammals</i>	<i>Mammalia</i>							
hare	<i>Lepus europaeus</i>	1	0.7	1.5	1	1.0	0.2	0.2
golden hamster	<i>Cricetus auratus</i>	3	2.0	4.5	1	1.5	0.3	0.3
family rats and mice	Muridae indet.	1	0.7	1.5	1			
total wild mammals		5	3.4	7.5	3	2.5	0.5	0.5
total identified mammals	<i>Mammalia</i>	65	43.9	97.0	11	463.0	96.3	99.8
unidentified mammals	<i>Mammalia</i> indet.	79	53.3	—	—	16.0	3.3	—
total mammals	total <i>Mammalia</i>	144	97.3	97.0	11	479.0	99.6	99.8
<i>birds</i>	<i>Aves</i>							
carion crow	<i>Corvus corone</i>	2	1.4	1.5	1	1.5	0.3	0.2
unidentified bird	<i>Aves</i> indet.	1	0.7	—	—	0.5	0.1	—
total birds	total <i>Aves</i>	2	1.4	1.5	1	2.0	0.4	0.2
<i>amphibians</i>	<i>Amphibia</i>							
toad	<i>Bufo</i> sp.	1	0.7	1.5	1	0.0 ³	—	—
total amphibians	total <i>Amphibia</i>	1	0.7	1.5	1	0.0 ³	—	—
NISP ¹		67	45.3	100.0	13	464.0	96.5	100.0
total bones		148	100.0		13	481.0	100.0	

1: NISP = number of identified specimen = total bones exclusive *Mammalia* indet., *Aves* indet.

2: MNI greater than 1 are evident by the following skeletal elements: 2 individuals of *Ovis*/*Capra* by 2 right mandibulae (ramus) and 2 right pelves (acetabulum).

3: less than 0.5g = below scale limit.



Fig. 9.4. Common starling (*Sturnus vulgaris*): habitus (from Adamian & Klem 1997, 137).

A view on the skeletal element distribution of cattle (Table 9.7), sheep/goat (Table 9.8) and pig shows that all body parts (skull, spinal column, fore limb, hind limb, feet⁶) are present. In cattle and pig an overrepresentation of the feet is visible, while in sheep/goat all body parts are equally distributed. This is expressed also in the low minimum number of individuals (MNI) allowing only evidence of three pigs, two cattle and five sheep/goat.

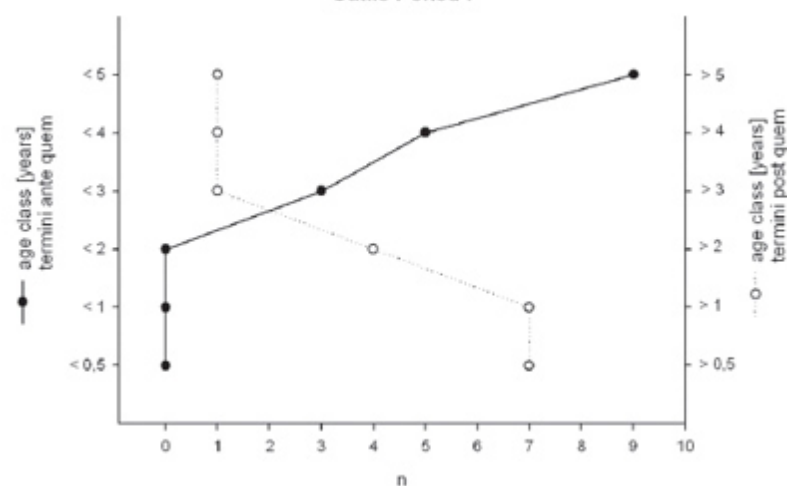
A selective view at the finds from grave 1 does not reveal any extraordinary features. Apart from the human mandibula fragment, the 15 animal bones comprise a broad spectrum of taxa (cattle, sheep/goat, pig, cock, vole) not significantly distinct from the overall pattern.

AGE, SIZE AND SEX DATA

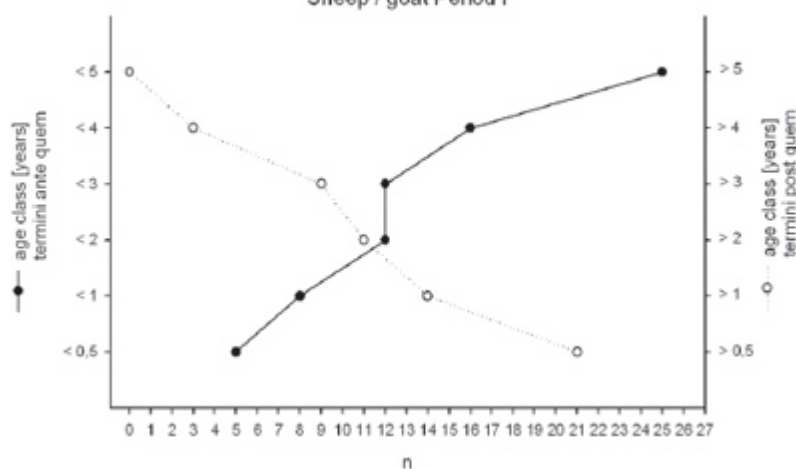
Sixteen cattle, 25 pig and 43 sheep/goat bones allowed age estimation by tooth eruption or epiphyseal fusion stages⁷ (Fig. 9.5 and Table 9.9). The assembled data show that most cattle were slaughtered between 1 and 3 years. Sheep and goat were spread over the age classes showing no peak in a certain age, but no specimen over 5 years was found. Only one bone of a pig older than 4 years was present, while most of the pigs did not survive the age of 2 years. The already mentioned fox cranium and one of the jird bones belonged to juvenile individuals. Two of the four Phasianidae bones were from juveniles, while all singing birds were adult. None of the bones from period I allowed morphological sexing.

Fifty bones from period I permitted measurement ([Table 9.6](#)). Twelve of these were from birds and two from rodents. One ulna (d002/155) and one radius (d002/156) of a single sheep that articulate together were completely preserved. After Teichert (1975, tab. 4) this sheep had a withers height of 62.5 cm ($GL \text{ of radius} \times \text{factor } 4.02$). The remaining measurable domestic mammal bones were either foot bones ($n=25$) or vertebrae ($n=3$) or only partly preserved. As mentioned before, no body size can be calculated from these skeletal elements, but compared with published data from other sites they seem to be from small animals (e.g. Kokabi 1982, 82–83; Reichstein 1994, 38–53, 172, 188). Although not measurable, one rib of a pig (s002,119) is quite large and may belong either to a wild boar or to an intruded modern domestic pig. One pig radius (d002,365) is affected by pathology (callus tissue at the lateral side).

Cattle Period I



Sheep / goat Period I



Pig Period I

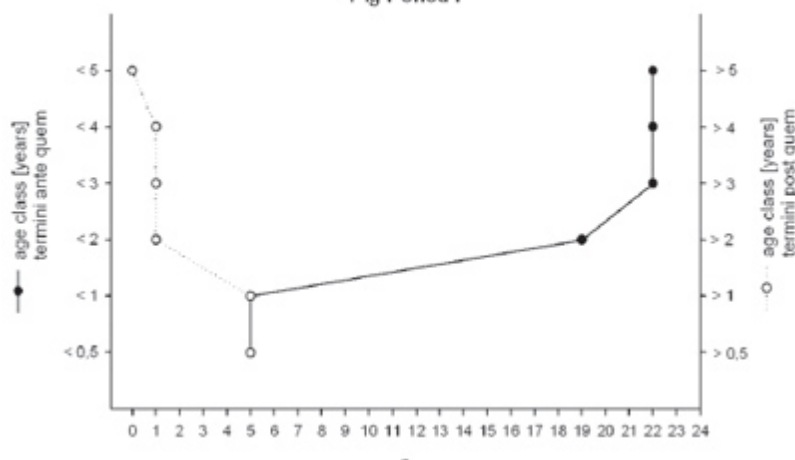


Fig. 9.5. Age spectrum of the most abundant domestic species from Aramus, area A, Period I. a) cattle (*Bos taurus*), b) sheep/ goat (*Ovis/ Capra*), c) pig (*Sus domesticus*).



Fig. 9.6. Perch (*Perca fluviatilis*): habitus (from Brandes 1976, 85).

Table 9.6. Measurements of animal bones from Aramus (according to von den Driesch 1976; 1999).

Species	Skeletal element	Measurements	N	Range	Mean	Bone no.	Surface unit
Period I							
<i>Bos taurus</i>	Astragalus	Bd 42.2	1			137	d 002
	Os tarsale 2 + 3	GB 29.4	1			151	d 002
	Scaphocuboid	GB 49.2	1			436	grave 1
	Patella	GB 60.0	1			139	d 002
	Phalanx 1	GLpe 57.1; Bp 31.4; (Bd 27.0); SD 26.0	1			144	d 002
	Phalanx 2	GL 40.3; Bd 23.2	1			146	d 002
		Bp	2	27.3–28.4	27.9	227	
		SD	2	23.0–21.8	22.4		
	Phalanx 3	GL S 56.3; Ld 43.0; MBS 18.5	1			147	d 002
	Radius	GL 155.5; LI 146.4; Bp 33.5; Bd 30.2; BFD 26.5; SD 15.9	1			156	d 002
<i>Ovis aries</i>	Ulna	GL 174.2; LO 39.9; DPA 29.6; SDO 23.7	1			155	d 002
	Metacarpus	Bp 22.9	1			158	d 002
	Tibia	Bd 27.8	1			170	d 002
	Calcaneus	GL	2	58.2–57.2	57.7	167	d 002
		GB	2	19.7–20.2	20.0	168	
	Phalanx 1 anterior	GLpe 34.4; Bp 11.8; Bd 1.5; SD 10.5	1			245	d 002
	Phalanx 1 posterior	GLpe	3	32.7–34.8	33.6	182	d 002
		Bp	3	11.2–12.6	11.8	186	d 005
		Bd	3	10.6–11.1	10.8	420	
		SD	3	9.3–9.8	9.6		
	Phalanx 2	GL	2	20.4–23.0	21.7	187	d 002
		Bp	2	9.4–11.5	10.5	246	
		Bd	2	7.1–8.1	7.6		
		SD	2	6.5–8.0	7.3		
	Phalanx 3	Ld 22.2; DiLS 28.3	1			189	d 002
		MBS	2	5.9–6.7	6.3	421	d 005
<i>Capra hircus</i>	Scapula	BG 23.1; SLC 20.8	1			173	d 002
	Metacarpus	Bp 24.4	1			159	d 002
	Tibia	Bd 29.8	1			169	d 002
<i>Sus domesticus</i>	Radius	Bp 25.9	1			218	d 002
	Phalanx 2 + III or IV	GL	2	21.4–21.5	21.5	127	s 002
		Bp	2	14.2–14.5	14.4	204	d 002
		Bd	2	11.8–12.9	12.4		
		SD	2	11.3–12.4	11.9		
	Phalanx 3 + III or IV	Ld 24.5; DiLS 26.7; MBS 10.3	1			128	s 002
<i>Canis familiaris</i>	Phalanx 1	GL 11.3; Bd 5.8; SD 4.3	1			376	d 002
<i>Homo sapiens</i>	Phalanx 1 + II post.	GL 28.4; Bp 12.4; Bd 9.0; SD 6.3	1			122	s 002
<i>Alactaga sp.</i>	Metatarsus	length (18.9); Bp 3.3; SD 2.2	1			388	d 002
<i>Arvicola terrestris</i>	Humerus	GL 17.5; Bp 4.6; Bd 5.1; SC 1.7	1			449	grave 1
<i>Gallus gallus</i>	Pelvis + Sacrum	DiA 7.3	1			448	grave 1
<i>Teirao</i>	Tarsometatarsus	Bp 12.9	1			381	d 002
<i>mfokasievici</i>							
<i>Sturnus sp.</i>	Coracoid	GL 24.3	1			416	d 003
	Humerus	GL 27.2; Bd 6.9; SC 2.6	1			411	d 003
		Dip	2	8.4–8.8	8.6	413	
	Ulna	Did 4.2; SC 2.0	1			414	d 003
	Femur	Bp 4.5	1			415	d 003
	Tibiotarsus	Dip 6.2	1			386	d 002
	Tarsometatarsus	GL 30.4; Bp 4.3; Bd 3.2; SC 1.8	1			387	d 002
Period II							
<i>Bos taurus</i>	Humerus	Bd 63.1; BT 63.6	1			570	d 018
	Metacarpus	Bd 68.5	1			580	d 021
	Phalanx 1	GL	3	49.0–52.6	51.0	586	d 021
		Bp	3	22.9–30.4	27.8	587	
		Bd	2	22.5–29.0	25.8	588	
		SD	2	19.7–24.4	22.1	589	
	Phalanx 2	GL 37.5; (Bp 27.8); Bd 22.4; SD 21.1	1			592	d 021
	Phalanx 3	Ld 51.3; DiLS 61.7	1			590	d 021
		MBS	2	13.2–20.4	16.8	591	
<i>Ovis aries</i>	Tibia	Bd 25.8	1			623	d 021
	Astragalus	GLm 27.8; Bd 18.3; Dm 16.0	1			524	d 012
	Calcaneus	GL 57.1; GB 20.1	1			622	d 021
	Phalanx 2 anterior	GL	2	23.4–24.4	23.9	492	d 011
		Bp	2	11.7–12.3	12.0	629	d 021
		Bd	2	8.8–9.6	9.2		
		SD	2	8.6–8.8	8.7		
	Phalanx 2 posterior	GL 22.7; Bp 9.9; Bd 7.6; SD 7.4	1			527	d 012

Species	Skeletal element	Measurements	N	Range	Mean	Bone no.	Surface unit
<i>Capra hircus</i>	Radius	Bp 26.4	1			618	d 021
	Metacarpus	Bd 26.3	1			624	d 021
	Femur	Bp 41.6	1			617	d 021
	Astragalus	(GLI 26.3); GLm 25.2; Bd 16.7; DI 14.2; Dm 14.5	1			491	d 011
	Phalanx 2 posterior	GL 24.8; Bp 10.8; Bd 9.0; SD 8.0	1			628	d 021
<i>Sus domesticus</i>	Phalanx 1	GLpe 31.0; Bp 15.2; Bd 13.1; SD 12.2	1			653	d 021
	Vertebra lumbalis	PL 31.8; BFer 35.8; BFed 31.6	1			685	d 021
<i>Canis familiaris</i>	Cranium	18 = 15.8; 20a = 11.3; B P4 = 6.9; 18a = 8.6; 20b (M1: B) = 13.2	1			523	d 012
Period III							
<i>Bos taurus</i>	Astragalus	GLI 55.0; GLm 50.1; Bd 35.8; DI 30.2; Dm 28.9	1			738	d 014
	Phalanx 1	GLpe 53.6	1			806	d 019
	Phalanx 2	GL 37.4; 39.4	2	37.4–39.4	38.4	777	d 013
		Bp 23.4; 29.4	2	23.4–29.4	26.4	778	
		Bd 20.8; 24.7	2	20.8–24.7	22.8		
		SD 19.5; 24.3	2	19.5–24.3	21.9		
<i>Ovis aries</i>	Scaphocuboid	GB 51.0	1			739	d 014
	Scapula	SLC 22.2	1			748	d 014
	Phalanx 1 posterior	GLpe 35.2; Bp 11.9; Bd 10.4; SD 9.4	1			730	d 009
	Phalanx 3	Ld 24.6; DiLS 30.3; MBS 6.7	1			731	d 009
<i>Capra hircus</i>	Phalanx 1 anterior	Bd 12.3	1			757	d 014
		GLpe	2	34.8–36.0	35.4	782	d 013
		Bp	2	12.2–12.5	12.4		
		SD	2	10.6–11.0	10.8		
	Phalanx 2 posterior	GLpe 19.4	1			786	d 013
	Phalanx 3	Ld 21.8; DiLS 28.0; MBS 4.4	1			792	d 019
<i>Equus caballus</i>	Os carpi radiale	GB 37.5	1			801	d 019
<i>Canis familiaris</i>	Phalanx 1	Bp 8.5; SD 5.6	1			762	d 014
<i>Corvus corone</i>	Ulna	Bp 9.8; Dp 11.1	1			787	d 013
<i>Sturnus vulgaris</i>	Humerus	GL 26.9; Bp 8.7; Bd 6.5; SC 2.7	1			728	d 004
not assigned features							
<i>Bos taurus</i>	Radius	Bp 40.7	1			846	d 016
	Phalanx 1	GLpe 53.2; Bp 23.7; Bd 22.0; SD 19.4	1			868	room 5
<i>Ovis aries</i>	Scapula	GLP 31.9; LG 23.8; BG 20.0	1			892	room 5
	Humerus	Bd 29.4	1			3	d 001
	Metacarpus	Bd 23.7	1			13	d 001
	Astragalus	GLm 29.2; GLI 30.0; Bd 19.0; DI 17.0; Dm 17.0	1			15	d 001
	Phalanx 1 anterior	Bp 13.5	1			7	d 001
		GLpe	2	35.8–37.2	36.5	8	
<i>Sus domesticus</i>		Bd	2	12.5–12.9	12.7		
		SD	2	10.7–10.7	10.7		
	Phalanx 1 posterior	GLpe 33.3; Bp 11.2; Bd 10.1; SD 9.0	1			9	d 001
	Atlas	GL (36.5); GB (64.5); BFer 40.2; BFed 51.2; H 37.5	1			928	room 5
	Phalanx 2	GL 23.5; Bp 13.0; Bd 10.0; SD 10.4	1			43	d 001
	Mandibula	7 = 87.2; 8 = 80.2; 9 = 74.9; 10 = 39.6; 11 = 42.3; 12 = 36.9; 14 = 24.5; 20 = 22.8	1			887	room 5
<i>Canis familiaris</i>	Mandibula + C 1 P2-M3	(1 = 133.0); (2 = 134.0); (3 = 126.5); (4 = 114.0); (5 = 109.0); (6 = 113.3); 10 = 34.5; 13 = 21.3; 18 = 56.4; 19 = 22.6;	1			836	DOST IV
	Metatarsus 5	Bd 8.6; SD 5.6	1			951	room 5
<i>Homo sapiens</i>	Metacarpus 3	Bp 12.5	1			857	d 016
<i>Vulpes vulpes</i>	Metacarpus 2	GL 42.7; Bp 4.1; Bd 6.4; SD 4.0	1			958	room 5
	Metacarpus 5	Bp 6.5; SD 4.9	1			959	room 5
	Phalanx 1	GL 19.7; Bp 5.6; Bd 4.8; SD 3.8	1			960	room 5
<i>Lepus europaeus</i>	Metatarsus 2	GL 55.5; Bp 8.0; Bd 6.6; SD 4.4	1			896	room 5
	Metatarsus 3	GL 56.6; Bp 5.1; Bd 6.6; SD 4.0	1			897	room 5
	Metatarsus 4	GL 54.7; Bd 6.0; SD 3.8	1			898	room 5
	Phalanx 1	GL 26.5; Bp 6.3; Bd 4.2; SD 3.2	1			899	room 5
	Phalanx 1	GL 21.4; Bp 6.0; Bd 4.3; SD 3.3	1			900	room 5
	Phalanx 1	GL 19.1; Bp 4.8; Bd 3.8; SD 2.6	1			901	room 5
<i>Anas strepera</i>	Ulna	SD 5.0	1			952	room 5
<i>Sturnus vulgaris</i>	Femur	GL 25.8; Lm 24.7; Bp 4.7; Bd 4.6; SD 2.1	1			891	room 5

Table 9.7. Skeletal element distribution of cattle (*Bos taurus*) from Aramus, area A, period I–III.

<i>Skeletal element</i>	<i>Period I</i>	<i>Period II</i>	<i>Period III</i>	<i>Total</i>
Cornu			1	1
Cranium	1	4	1	6
Mandibula	1	2	2	5
Dentes	6	4	3	13
Hyoid				0
Atlas	1			1
Axis	1			1
Vertebrae	5	2		7
Sacrum	1	1	1	3
Costae	5	1	2	8
Scapula	2			2
Humerus	1	1		2
Radius	1	2		3
Ulna		2		2
Carpalia				0
Metacarpus	7			7
Pelvis	5	1	2	8
Femur		1	1	2
Patella	1			1
Tibia	3	1		4
Fibula				0
Astragalus	2		1	3
Calcaneus	1			1
Tarsalia	2		1	3
Metatarsus		1		1
Metapodium	3			3
Phalanx 1	1	3	1	5
Phalanx 2	2		2	4
Phalanx 3	1			1
Sesama			1	1
Total	53	26	19	98

Period II

Species and skeletal element representation

From period II layers 740 fragments were recovered, of which 387 (52.3%) were identifiable (Table 9.4). The most outstanding figure in period II is the unexpected high amount of wild mammals (n=203). This is caused by 169 jird bones (*Meriones persicus*, Fig. 9.3). The majority of these (n=129, d012,69-113), belonging to a minimum number of three individuals, was found together, partially articulated in a burrow in stratigraphic unit d 012. Breeding burrows of *Meriones* can be over 1m deep (Piechocki 1977a, 342), while layer d 012 is

situated approximately half a metre below the surface. These individuals obviously dug themselves into the already stratified layer and died there. Since not enough data about historical gerbil distribution is available at present, it cannot be ruled out, that gerbils were living in Aramus even in prehistoric times. But, although jirds do live in the vicinity of human settlements, they are freeland species and do not follow human civilisation into building structures like the rat (*Rattus* sp.) and the house mouse (*Mus musculus*) (Piechocki 1977a, 342–343). All these arguments add weight to the assumption that the gerbils are modern intrusions. For the remaining 34 rodent bones, two of which are of a golden hamster (*Cricetus auratus*, d011/497, d012/535), it cannot be ruled out that they may be intrusive as well. Except these micro-mammals no other wild mammals were found in period II.

Table 9.8. Skeletal element distribution for sheep (Ovis aries) and goat (Capra hircus) from Aramus, area A, period I–III.

<i>Skeletal element</i>	<i>Period I</i>	<i>Period II</i>	<i>Period III</i>	<i>Total</i>
Cornu				0
Cranium	7	3	1	11
Mandibula	4	1	3	8
Dentes	10	10	6	26
Hyoid		1		1
Atlas		1		1
Axis		1		1
Vertebrae	15	4		19
Sacrum		1		1
Costae	11	7	3	21
Scapula	1	4	1	6
Humerus	1	4	1	6
Radius	4	2		6
Ulna	5	2		7
Carpalia				0
Metacarpus	6	1	2	9
Pelvis	1	1	4	6
Femur	5	6	2	13
Patella				0
Tibia	6	3	1	10
Fibula				0
Astragalus		3		3
Calcaneus	2	1		3
Tarsalia				0
Metatarsus	6	2		8
Metapodium	4	3	2	9
Phalanx 1	9	1	4	14
Phalanx 2	2	4	2	8
Phalanx 3	2		2	4
Sternum	1		1	2
Total	102	66	35	203

Table 9.9 Age spectrum of cattle, sheep/goat and pig from Aramus, area A, Period I.

Species		Age class						Total
cattle	<i>Bos taurus</i>	> 0.5yrs	> 1yr	> 2yrs	> 3yrs	> 4yr	> 5yrs	16
		7	7	4	1	1	1	
		<0.5yrs	<1yr	<2yrs	<3yrs	<4yr	<5yrs	
sheep/goat	<i>Ovis/Capra</i>	—	—	—	3	5	9	43 ²
		> 0.5yrs	> 1yr	> 2yrs	> 3yrs	> 4yrs	> 5yrs	
		21	14	11	9	3	—	
pig	<i>Sus domesticus</i>	<0.5yrs	<1yr	<2yrs	<3yrs	<4yr	<5yrs	25 ⁴
		5 ¹	8	12	12	16	25	
		> 0.5yrs	> 1yr	> 2yrs	> 3yrs	> 4yrs	> 5yrs	
pig	<i>Sus domesticus</i>	5	5	1	1	1	—	25 ⁴
		<0.5yrs	<1yr	<2yrs	<3yrs	<4yrs	<5yrs	
		5 ³	5	19	22	22	22	

1: all neonatus

2: 3 specimen gave a time span and were counted twice.

3: 4 × neonatus

4: 2 specimen gave a time span and were counted twice.

Table 9.10. Age spectrum of cattle, sheep/goat and pig from Aramus, area A, Period II.

Species		Age class						Total
cattle	<i>Bos taurus</i>	>0.5yrs	>1yr	>2yrs	>3yrs	>4yr	>5yrs	21 ¹
		12	12	4	1	—	—	
		<0.5yrs	<1yr	<2yrs	<3yrs	<4yr	<5yrs	
sheep/goat	<i>Ovis/Capra</i>	—	—	1	4	5	10	21 ²
		>0.5yrs	>1yr	>2yrs	>3yrs	>4yrs	>5yrs	
		15	9	4	4	2	—	
pig	<i>Sus domesticus</i>	<0.5yrs	<1yr	<2yrs	<3yrs	<4yr	<5yrs	13 ¹
		—	1	2	2	3	9	
		>0.5yrs	>1yr	>2yrs	>3yrs	>4yrs	>5yrs	
pig	<i>Sus domesticus</i>	4	3	2	1	1	—	13 ¹
		<0.5yrs	<1yr	<2yrs	<3yrs	<4yrs	<5yrs	
		1	4	7	7	8	10	

1: 1 specimen gave a time span and was counted twice

2: 3 specimen gave a time span and were counted twice.

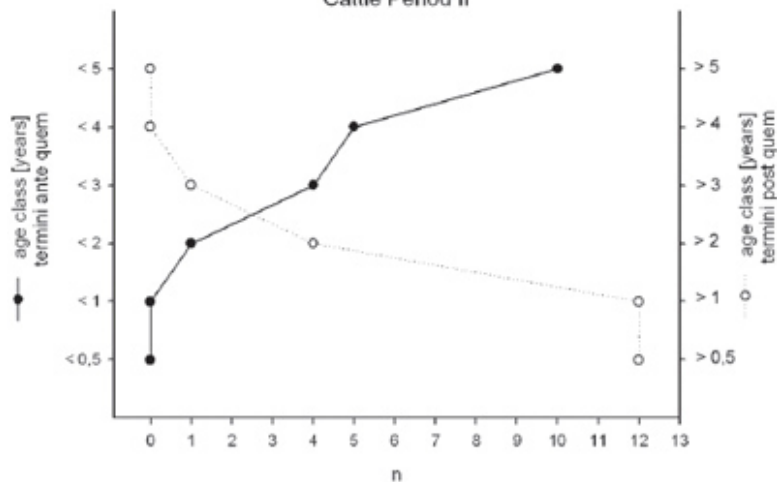
Cattle exceed all other species by number (n=79) and even more explicitly by weight (ca. 70% of the total bone weight) in period II, ovicaprids rank second (n=66) followed by pigs (n=26). Period II produced the first evidence of equids (family Equidae, n=4). Three of

these were from the domestic horse (*Equus caballus*), while one metatarsus (d011/484) belonged to a donkey (*Equus asinus*). One skull fragment proves the existence of dogs in period II.

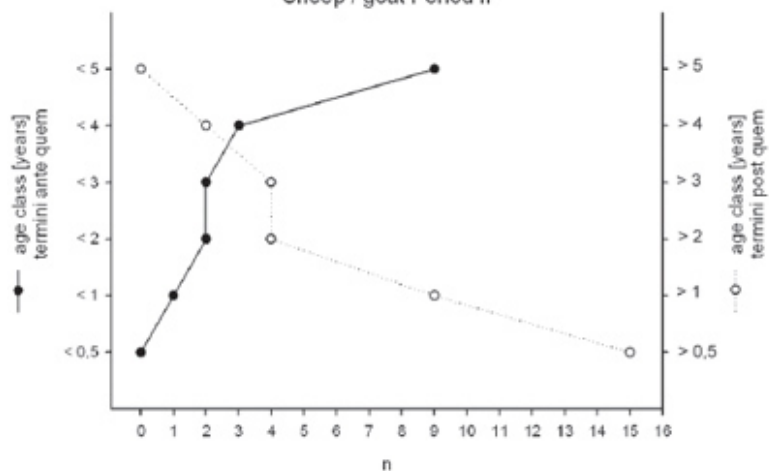
A surprise was the presence of 25 fish bones in sieved samples from layer d 011, six of which could be attributed to three different families, the salmons and trouts (Salmonidae, n=1), the minnows (Cyprinidae, n=3) and the perches (Percidae, n=2). One perch bone could be assigned to the species *Perca fluviatilis* (Fig. 9.6). As it is unlikely for fish to accumulate by natural means on a hilltop, it is a reasonable assumption that they were brought into the site by the inhabitants.

This fosters the hypothesis of wetlands in the vicinity of Aramus, which is also supported by the finding of plant macrofossils (Hovsepyan pers. comm.). Only very few fish bones have been discovered from archaeological sites in Armenia so far, including singular remains of carp (*Cyprinus carpio*) and sheat-fish (*Silurus glanis*) from the Urartian city of Argistichinili (Manaseryan 2003, 101–102). The results of the sieving experiment suggest that the rareness of fish remains in Urartian bone assemblages may be a methodological bias instead of an assumed avoiding of fish diet (Manaseryan 2003, 102). The samples also contained one pelvis fragment of a true frog (genus *Rana*), for geographical distribution and size reasons this can only be *Rana macrocnemis camerani* (Engelmann *et. al.* 1985, 166–167, 177–179). The remaining small fragments from the sieved samples (n=182) do not have diagnostic features allowing morphological identification, although most are from mammals, judging by their bone structure, texture and overall appearance. The extraction of fish and amphibian remains from only 20 litres of soil expresses convincingly the potential of the sieving method for the analysis of the site.

Cattle Period II



Sheep / goat Period II



Pig Period II

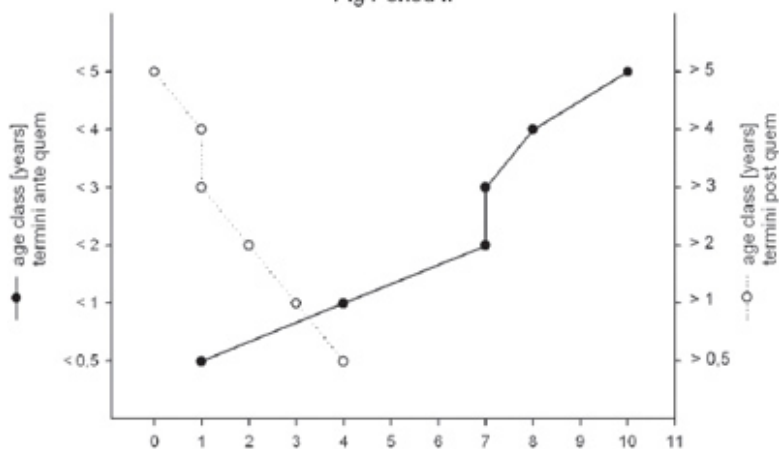


Fig. 9.7. Age spectrum of the most abundant domestic species from Aramus, area A, Period II. a) cattle (Bos taurus), b) sheep/goat (Ovis / Capra), c) pig (Sus domesticus).

Skeletal element distribution shows that all body parts of cattle (see [Table 9.7](#)), sheep/goat (see [Table 9.8](#)) and pig are represented. They are evenly distributed in sheep/goat, while in cattle and pig skull fragments are slightly overrepresented. Multiple existence of skeletal elements proves two individuals of cattle, three ovicaprids and two pigs.

Age, size and sex data

Features for age estimation were preserved on 21 cattle, 21 sheep/goat and 13 pig bones ([Fig. 9.7](#) and [Table 9.10](#)). In period II ovicaprids were evenly distributed in age classes between one and five years, while cattle reached between one to three years and pigs between half a year and two years.

Measurements could be taken from 30 bones ([Table 9.6](#)). Two teeth remaining in a dog skull fragment (d021/523) are smaller than the teeth of a skull published by Kokabi (1982, 91–96), which belonged to a dog similar to a Fox Terrier in size (withers height 39cm; Harris 1995, 257). All other bones are either fragmented or elements from the feet (n=19) and do not provide a reliable base for a size analysis. One distal fragment of a cattle metacarpus (d021/580; [Table 9.6](#)) is rather large and almost certainly belonged to a male animal (Kokabi 1982, 45, 49; Reichstein 1994, 78–80). A pig mandible (d021/650) could be attributed to a sow.

Period III

Species and skeletal element representation

The number of bones retrieved from period III is 148 with an NISP of 67 (45.3%). Species representation shows again an abundance of ovicaprids in bone number, while cattle comprise more than 50% of the bone weight ([Table 9.5](#)). Pig, horse and dog are present by singular bones. The only wild mammal found is a vertebra of a hare (d009/732), which results in a domestic to wild mammal ratio of 60:1 (excluding rodents). The amount of rodent bones declines down to four in period III. Three of these (1 skull, 1 mandible, 1 atlas) belong to one individual of a golden hamster and were still articulated when found. Period III layers contained three bird bones, two of the carrion

crow (*Corvus corone*, d014/772, d013/787) and one phalanx that is morphologically close to a heron (family Ardeidae, d009/734).

Good preservation conditions were again proved by the find of a toad humerus (*Bufo* sp., Fig. 9.8a). This can only be from the green toad (*Bufo viridis*, d009/733, Fig. 9.8b), since it is the only species of toad living in Armenia (Dal 1954, 300; Engelmann *et al.* 1985, 149, 154). Except for two sheep/goat the MNI is one for all species.

No bones of the forelimb of cattle are preserved, while most specimen belong to the skull (n=7) or the feet (n=6) (Table 9.7). A similar picture can be seen in ovicaprids (12 feet, 10 skull, 2 fore limb, 7 hind limb; see Table 9.8). The number of pig bones is too small to compare skeletal elements.

Age, size and sex data

Only three cattle bones from period III allowed age estimation, all belonging to individuals older than 1 year. Of the eight ovicaprid bones with preserved ageing criteria, seven were at least 6 months old and one was older than 4 years. One phalanx of a dog (d014/762) must be older than 5 months.



Fig. 9.8. Green toad (*Bufo viridis*). a) humerus (d009/733) (Photo: Scheffka); b) habitus (from Engelmann et al. 1985, 153).

Only 15 bones of the autopodium of cattle (n=5), sheep/ goat (n=8), horse (n=1) and dog (n=1) were measurable. No bone with sexing criteria is preserved from period III.

Bones from features not assigned to a chronological period

These comprise 172 specimen out of area A from the stratigraphic units d 001 (n=110), d 004 (n=2), d 016 (n=51) and Locus DOST IV (n=9) plus 275 specimen out of area B from room 5 (n=263) and room 6 (n=12).

Because the finds from the surface layer d 001 are a mixture of modern and archaeological finds, they can only add an impression of the species represented (Table 9.2). This impression is consistent with the general picture and will not be discussed here any further. Worth mentioning is a fragment of a cattle rib (d001/51) with callus tissue at its distal end, indicating a fracture or an inflammation.

From stratigraphic unit d 004 two bones – a vertebra of a cattle and a humerus of a common starling – were recovered. The few identifiable bones from stratigraphic unit d 016 showed the same pattern as periods I–III with sheep/goat (n=7), cattle (n=5) and pig (n=2). Apart from five undetermined mammals Locus DOST IV contained two cattle fragments (1 mandible, 1 radius), a nearly complete right mandible of a dog (DOST IV/836, Fig. 9.9) and a fragment of a dog canine belonging to another mandible. Although the mandible 836 is broken into three pieces, several measurements could be taken (see Table 9.6).



Fig. 9.9. Dog mandible (DOSTIV/836) from Aramus (Photo: Scheffka).

Compared with the dog mandibles found at the site of Beniamin, Armenia (1st millennium BC, n=12) this individual was at the lower margin of the size range represented there (Manaseryan 2000; Mirzoyan 2011). According to Kokabi (1982, 92–95) individual 836 was bigger than a Fox Terrier (withers height 39cm; Harris 1995, 257), but slightly smaller than a German Shepherd (withers height ca. 55–65cm; Harris 1995, 243).

Area B is identical with room 5 and 6 of the area excavated by Avetisyan. These rooms were filled up with the excavated soil when the dig was closed in 1988. Hence, most finds from area B (n=252)

are from disturbed layers and cannot be assigned to a cultural period. These bones can only contribute to the species representation, which is consistent with the other assemblages (see [Table 9.2](#)). Six hare bones, one common starling, one gadwall (*Anas strepera*) and one house sparrow (*Passer domesticus*) may be mentioned. Measurements could be taken from the 5th metatarsus of a dog (room5/951; [Table 9.6](#)) from room 5 (southeast corner). Compared with the data given by Ratjen and Heinrich (1978, 38), this bone fits in the range of the modern breeds German Boxer, Airedale Terrier, Chow Chow and Standard Poodle, which are all medium-sized breeds of 45–63 cm withers height (Goerttler 1972, 212–219; Harris 1995, 194, 223, 233, 240). A dog mandible (room5/887) belonged to an individual larger than a German Shepherd. This dog was at the upper size range of the Benjamin dogs (Manaseryan 2000; Mirzoyan 2011). It has to be stated that these single measurements should be viewed with care and should not be used as a base for further conclusions concerning the phenotype of the dogs inhabiting ancient Aramus.

Apart from these unstratified finds, 23 bones were recovered from an undisturbed feature in room 5, which has been preliminary assessed as a storage silo pit and will probably be datable. The identifiable part of this sub-sample (n=11) consists of two sheep/goat, three fox, five rodent and one singing bird bone. According to the data given in Ratjen & Heinrich (1978, 26, 39) one metacarpus III of a fox (958, [Table 9.6](#)) fits in size and proportions into the range of a female. No age data could be drawn from bones of the silo filling.



Fig. 9.10. a) Slaughtering of a sheep at the Geghard monastery (Photo: Küchelmann). b) Foot of a goat (*Capra hircus*) left by villagers on the path leading to the excavation site. A piece of rope used for hanging the body head down during the slaughtering process is still attached. (Photo: Küchelmann).

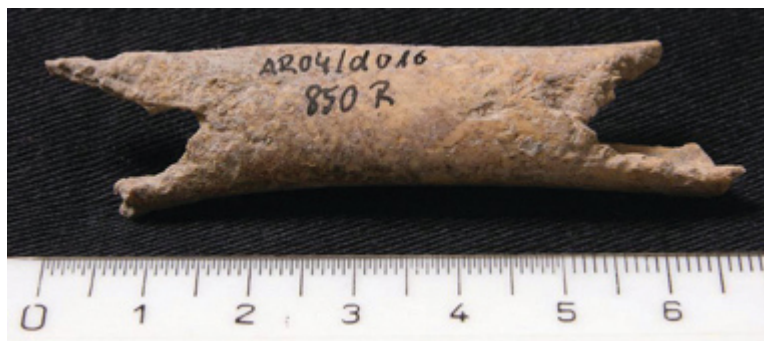


Fig. 9.11. Sheep radius (d016/850) with ungulate gnawing marks. (Photo: Scheffka).

Taphonomy

While the general preservation status of the bone material is excellent, only 193 out of the total of 1860 bones are completely preserved (degree of fragmentation = 89.6%). These mainly consist of rodents ($n=94$) and the compact bones of the autopodium of domestic ungulates ($n=70$). A closer look at the domestic mammals shows that only 81 (14.0%) of the total of 577 are not fragmented. This is consistent with the generally accepted thesis of meat processing refuse, showing a high degree of fragmentation. The bones of the autopodium only contain a small amount of consumable tissue and therefore are often thrown away without processing (Fig. 9.10). Further, they are more resistant to fragmentation than other bones due to their bone structure.

Direct evidence of meat procurement as proved by tool marks (impact marks, cut and scraping marks) could be observed on 5–10% of the sub-samples from the different periods (Table 9.11). Tool marks found on the identified bones only appeared on domestic species (31 cattle, 47 ovicaprids, 9 pig, 1 horse, 1 cock). In cattle and ovicaprids tool marks were evident on all body parts, but were not analysed for location patterns. Traces indicating the use of bones as handcraft raw material or artefacts (e.g. sawing marks, polish, use wear) have not been found. Evidence for the influence of fire could be observed on 71

bones (Table 9.11). While 62 of these were charred and can be interpreted as cooking remains, only nine were calcined.⁸ The charred specimens are distributed over the different periods ranging from eight (9.2%) in period III, more than 14 (4.2%) in period I to 24 (7.2%) in period II. In relation to species, charring also appears only on domestic animals (13 cattle, 10 sheep/goat, 1 pig, 2 dog). Noteworthy are two charred first toe joints from dogs from period I and III (d002/376, d014/762), raising the question whether dogs in Aramus were eaten. Calcined bones were only found in period I and II and the identifiable ones are an astragalus of a goat (d011/491) and a 1st phalanx of a sheep (d011/492).

Between 10% and 15% of the sub-samples showed carnivore bite marks adding to a total of 127 (Table 9.11). Distribution by species is proportional to the taxa recorded (40 sheep/goat, 34 cattle, 20 pig, 3 hare, 3 singing bird, 1 horse, 1 rodent). The real percentage of carnivore bite marks is in fact higher because 435 small unidentifiable fragments have not been, because of practical reasons, monitored for bite marks, weathering and root etching. One specimen (d016/850; Fig. 9.11) shows marks of ungulate gnawing (Küchelmann 2009, 151–152; Sutcliffe 1973).

Weathering is, by definition, visible damage on bone surfaces lying exposed on the ground and caused by repeated climatic changes (Behrensmeyer 1978⁹). The specific destruction patterns that develop on weathered bones could be observed on a relatively high number of finds (n = 573) with an abundance between 41% in period II and 71% in period I (Table 9.11). This reveals that a significant part of the bones had been lying on the soil surface for several years, before the following layer formed. Root etching is caused by acids secreted from the roots of several plant species growing adjacent to bones embedded in the soil. These traces are visible on 225 specimens with the lowest value in period II (12%) and the highest in period I (32%). A conclusion from these features is that the bones remained on or just underneath the soil surface for a longer time span in period I than in period II. This indicates that the formation of period II was a faster process than that of the period I. In the case of period III the values lie between those of period I and II, but here again the number of bones found is very small.

Other results

One fragment of a cattle metacarpus from stratigraphic unit s 002 (s002/126) matches with a fragment from stratigraphic unit grave 1 (grave1/437). The breakage is old and not a digging artefact. Possible

implications of this correlation are that either both layers were formed in the same time period or grave 1 was dug into layer s 002.

In the case of a cattle mandible (d002/141) bite marks superimposing cutmarks were visible thus proving the secondary use of human meat processing refuse by carnivores, most probably dogs.

Synthesis

The animal bone material from the 2004 excavation at Aramus consists of 1860 fragments, of which 867 (46.7%) were identifiable (NISP). Except reptiles, species of all vertebrate classes were found (Tables 9.2–9.5). While the vast majority of the material comes from mammals (n=1625), birds (n=26), fish (n=25) and amphibians (n=2) are present in small numbers. As to be expected in a settlement of a society with a highly developed agricultural system, the bulk of the assemblage (n=577; 66.6% of NISP) consists of domestic mammals (cattle, sheep, goat, pig, horse, donkey and dog). Apart from 241 rodent bones, wild mammals are underrepresented with only eight hare and five fox bones and even these may be intrusive. Assumed they are not, the domestic to wild mammal ratio is 44.4:1.

Species distribution over the three time periods I–III shows a predominance of the small ruminants (sheep and goat) followed by cattle and pig, except for period II, where the number of cattle bones exceeds the ovicaprids (Table 9.2). With over 50% of the bone weight, cattle are most important in all periods (Tables 9.3–9.5), especially in period II, where they reach 71% of the total weight. Single bones of dogs were found in all periods, horses only appear in period II and III, and one donkey bone was found in period II.

Table 9.11. Occurrence of taphonomic features on bones from Aramus, excavation 2004, area A and B.

Taphonomic feature	Surface layer d 001		Period I		Period II		Period III		Not assigned features ¹		Room 5 + 6		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
impact marks	6	9.0	32	9.6	16	4.8	6	7.0	2	6.7	2	1.4	64	6.5
cut marks	4	6.0	25	7.5	26	7.8	8	9.2	1	3.3	5	3.5	69	7.0
scraping marks					2	0.6			2	6.7			4	0.4
charred	1	1.5	14	4.2	24	7.2	8	9.2	2	6.7	13	9.2	62	6.3
calcined			4	1.2	4	1.2					1	0.7	9	0.9
carnivore bite marks ²	7	10.4	39	11.7	47	14.2	9	10.3	11	36.7	14	9.9	127	12.8
rodent gnawing marks			7	2.1	2	0.6							9	0.9
digestive acid corrosion			2	0.6							2	1.4	4	0.4
weathered ²	34	50.7	238	71.3	136	41.0	52	59.8	20	66.7	93	65.5	573	57.8
trampling	1	1.5											1	0.4
root etching ²	11	16.4	108	32.3	40	12.0	24	27.6	7	23.3	35	24.6	225	22.7
total monitored	67		334		332		87		30		142		992	
of sub-sample														

1: stratigraphic units d 004, d 016, Locus DOST IV.
2: 435 fragments of unidentified mammals have not been monitored for carnivore bite marks, weathering and root etching.

Rodents are present in all periods, with the broadest spectrum of species (Persian jird, common vole, golden hamster, jerboa) in period I and the highest number of bones ($n=203$) in period II (Tables 9.2–9.5). Since all 182 identified rodent bones are from burrow-building species (Piechocki 1977a, 342; 1977b, 397; van den Brink 1957, 83–104), it cannot be decided in each case, if the found animals were contemporary with the formation of the archaeological layers, or if they intruded into the strata by burrowing. In the former case they may have been commensal or a pest for the people living in the ancient settlement. In the latter they are modern inhabitants of the site and should be excluded from the archaeological analysis. In some cases contextual information provides clues, as with the gerbils from period II.

Bird species identified comprise domestic cock, gadwall, black-billed magpie, carrion crow, common starling and house sparrow (Figs 9.5–9.7). Unexpectedly the most abundant species ($n=9$) is the common starling, ranking even before fowl ($n=7$). Most bird bones ($n=18$) were found in period I, raising the question if this uneven distribution is just a random bias or if birds in general and starlings in particular had a significance in that period.

The 25 fish bones from period II are undoubtedly a methodological bias caused by the more accurate sieving methods employed. Six of the fish bones could be assigned to the families Cyprinidae, Percidae and Salmonidae.

Skeletal element distribution in cattle (Table 9.7), ovicaprids (Table 9.8) and pig reveals that all body parts (skull, spinal column, fore limb, hind limb, feet) are present in period I and II. In period III sheep/goat are represented by all body parts as well, whereas cattle are missing the forelimb. A slight over-representation of the skull in period II and III and of the feet in Period I and III is visible in cattle. In sheep/goat body parts are evenly distributed in period I and II, while in period III feet and skull are overrepresented. The pig feet elements are overrepresented in period I and skull fragments in period II. In general the bone numbers for each period are too small for statistical analysis and hence the distribution data does not allow wide ranged conclusions.

Monitoring the age spectrum (Figs 9.5, 9.6, Tables 9.9, 9.10) of period I–II reveals that cattle were killed at an age of 1–3 years. Sheep and goat found between 1 and 5 years old were evenly distributed. Most pigs were aged between 6 months and 2 years. This pattern indicates that pigs as well as cattle were mainly raised for meat production, while a certain proportion of sheep and goats were kept

longer e.g. for breeding, milking or wool production. Generally this becomes even more evident when the sex ratio is taken into account – usually in such circumstances the portion of females kept is higher than the portion of males – but unfortunately not enough bones allowed morphological sexing.

The data basis for a metrical analysis of the bone assemblage is very small. Only two long bones of adult domestic mammals were completely preserved allowing the application of the available standard factors for the calculation of body size. These two bones belong to one individual of a sheep from period I with a withers height of 62.5cm. A skull fragment of a small dog was recovered from period II. A dog mandible slightly smaller than a German Shepherd was found in Locus DOST IV. Another mandible fragment of a large dog (larger than a German Shepherd) and a metatarsus of a medium sized dog were excavated in room 5. The abundant complete compact foot bones of domestic mammals (n=91) allow only a relative estimation of size in comparison with populations where a larger series of data is available. This intensive research task could not be undertaken because of the limited time and financial resources available to the first campaign and has had to be left for the future.

Except for three pigs in period I, three sheep, goat and three jirds in period II the MNI never exceeds two individuals (Figs 9.5–9.7). Only three bones allowed morphological sexing, one mandible of a sow, one metacarpus of a male cattle and one metacarpus of a female fox. Two bones show pathologic changes in the form of callus tissue.

Close examination for traces of taphonomic processes revealed a high degree of fragmentation, frequent tool marks and charring on bones of domestic animals. These features are in accordance with the expectation of an assemblage of daily meat consumption refuse from a highly developed agricultural and stock rearing society. Worth mentioning are two charred dog bones indicating possible dog consumption. Calcinated bones are rare, bone-working traces were not observed. Non-human agents leaving their traces on the bone finds were carnivores (frequent), rodents, ungulates, plants and weathering.

Outlook

As the preservation conditions for animal bones could be proved to be excellent, a high amount of additional bone finds can be expected for forthcoming excavations in Aramus. The successful results from the tests with the wet sieving method show that an intensification of soil sampling and sieving would be desirable in future. A further

suggestion is the use of the flotation method for the regular processing of soil samples, which would greatly increase efficiency. This would probably result in the extraction of more fish bones, highlighting the fish diet of the inhabitants of the settlement. Special attention should be paid to future finds of singing bird bones and their distribution in the stratigraphy to verify or falsify a possible significance for the people of ancient Aramus. The finds of singular human bones on the eastern acropolis (area A) make it probable that further graves will be found in the vicinity of grave 1.

Provided adequate funding is available more effort could be invested in the metrical analysis of the bone assemblage, especially in the case of dogs. Further, there is the possibility to analyse tool mark patterns to get an indication of craftsman's methods and handicrafts conducted in Aramus.

Future ideas include a comparative analysis between Aramus and material from other archaeozoologically examined Urartian sites like Argistichinili (Armavir) (Martirosjan 1974, 121, 142–144; Salvini 1995, 132), Akhtamir (Gautier & Vandenbruane 1997), Bastam (Boessneck & Kokabi 1988; Kroll 1988; Krauß 1975; Zimansky 1988), Beniamin (Mirzoyan 2011), Horom (Badaljan *et al.* 1994; 1997, 191–193; Obermaier 2006), Arin-Berd (Erebuni) and Karmir-Blur (Teishebaini) (Martirosjan 1974, 144). Further the bone finds need to be compared with iconographic, written and material evidence related to animals in Urartu (see e.g. Arutunjan 1964, 139–204).

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Notes

- 1 The project was organised by Sandra Heinsch and Walter Kuntner (Institut für Alte

- Achetevet und Altorientalistik. Zentrum für Alte Kulturen, Universität Innsbruck) und Hayk Avetisyan (Department of History, University of Yerevan).
- 2 The report has been delivered to the organising institutes 2006. A former version has been published online on the websites of the Aramus project and the first author (http://www.knochenarbeit.de/eigene_arbeiten/aramus_2004.pdf).
- 3 *Spalax graecus* (NMW 2158), *Spalax microphthalmus* (NMW 2433), *Allactaga major* (NMW no no.), *Cricetulus migratorius* (NMW 18268), *Ellobius fuscocapillus* (NMW 12052).
- 4 History Museum of Yerevan, Argishti Street 1, Yerevan, Armenia, tel, + 374-1-568185
- 5 Three species of *Meriones* inhabit the region of Kotayk, *M. persicus*, *M. blacklerii* and *M. vinogradovii* (Dal 1954, 167–168; Gepner & Naumov 1972, 167; Oganessyan, pers. comm. 10-2005). The bones match perfectly with *M. persicus*, which is smaller than the latter species. However, since reference skeletons of *M. blackleri* and *M. vinogradovii* were not available, they cannot be ruled out with certainty at present.
- 6 Although they are belonging to the limbs in strict sense, the foot bones are separated here because of their specific anatomical properties further explained in the taphonomy chapter.
- 7 The crux with ageing data is that in most cases the epiphyseal fusion stage does only give a terminus ante or post quem. Only in a few occasions (tooth status in juvenile mandibles, visible fusion lines, neonates) an exact age or a time span can be obtained.
- 8 The term ‘calcination’ defines bones that have been affected by great heat for a prolonged time period resulting in a total loss of the organic component, leaving only the anorganic component with a grey or white, cracked appearance.
- 9 The study of Behrensmeyer (1978) was conducted in Kenya and has to be viewed as a preliminary indication since it is not applicable to every climatic situation (see e.g. Andrews 1990, 10–17; Tappen 1990).

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10. Analysis of Urartian bone remains from Erebuni, Armenia (2003–2007 excavations): possible use of bones for the manufacture of paint

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Erebuni citadel with its royal palace, temple, storerooms and surrounding buildings represents a very important site located on the south-eastern part of modern Yerevan city. As the excavations of the last ten years have shown, it is a multi-layer site founded by the Urartian king Argishti I in 782 BC. Started in the early 1960s, excavations at the site revealed many interesting points about the life of Urartian people. Excavations continue today and osteological material forms part of the most interesting finds from the site. This paper reports the results of the analysis of bone remains from the 2000–2007 excavations at Erebuni, which have never previously been published. They include the list of identified species, measurements of skeletal elements, taphonomic marks and a discussion of the use of animal bones by the Urartians as raw material for different purposes. In addition, the representations of animals in Urartu art will be discussed.

Keywords Erebuni Citadel, Urartu, Armenia, 1st millennium BC, Archaeozoology, paint

Introduction

The citadel of Erebuni is located on the hill Arin-berd in the south-eastern part of modern Yerevan, Armenia, at 1200m above sea level (Fig. 10.1). It is a superb architectural complex with fortification walls and a palace, as well as religious and economic structures. Excavations began in the early 1950s and unearthed a temple of the Urartian God

Haldi and a Susi temple dedicated to the God Ivarsha, alongside a palace complex with a pillar courtyard and economic structures (Fig. 10.2). These buildings date back to the Urartian period (8th–7th centuries BC) and were later reconstructed during Post-Urartian and Achaemenian times. The excavations that were initiated in 1998, by a team led by Dr Felix Ter-Martirosov¹ from the Erebuni museum, aimed at increasing the excavation area in order to clarify the stratigraphy of the site, as well as the boundaries of the various cultural layers. Armed with these goals, the excavation started on the northern slopes of Erebuni hill, which lies 18m below the current ground level paved during the reconstruction of the site in the 1970s (Ter-Martirosov 2005). The four stratigraphic layers that have been analysed date back to the Urartian second and first periods (8th–7th centuries BC), Achaemenian (mid-6th–4th BC) and post-Achaemenian periods (early 3rd century BC–7th century AD) (Ter-Martirosov 1998). Two additional layers dating back to the 3rd Urartian period and the early Iron Age were also located, but these are not yet excavated. Excavations at the site are still on-going.

Several of the structures at the Erebuni citadel are well preserved. During the many years of excavations, a significant amount of material finds have been retrieved from the cultural layers of the site. While most of the material finds, as well as the architectural structures of Erebuni, have been well studied and published, the faunal remains have not received the same level of detailed analysis. Recently, studies of animal bone remains from two Urartian layers, excavated during the 2003–2007 excavations at Erebuni, have been conducted in the Research Centre of Zoology and Hydroecology of the Armenian National Academy of Sciences. In this paper the results of the analysis of this material are discussed to show the role of animals in the diet and the subsistence economy, as well as in the cultural and religious aspects of Urartian society.

An experiment is carried out to demonstrate the possible use of yellow paint derived from animal bones. This study then provides a discussion of the representations of animals depicted in Urartian architectural remains and on art objects, as well as animals mentioned in Urartian inscriptions.

Material and methods

The study of the faunal remains from the 2003–2007 excavation seasons includes material from the 1st and 2nd Urartian periods, found on the northern slope of Erebuni hill. The assemblages are

dated to the Urartian periods (end of 8th–early 7th centuries BC), which are represented in several loci. All samples were collected by hand during the excavation process. All the remains were cleaned by dry-brushing to remove excess dirt and the elements were counted, partially weighed² and registered.

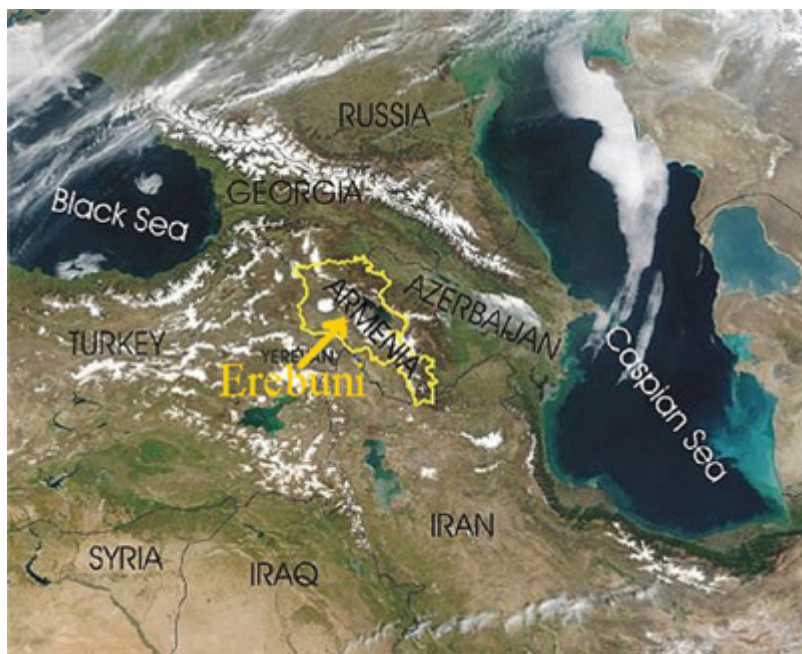


Fig. 10.1. Location of Erebuni in Armenia.

In total, 1150 fragments were identified to the rank of class, order, genus or species. The identification was verified utilizing modern skeletal specimens from the comparative osteological collection of the Scientific Center of Zoology and Hydroecology (Armenian National Academy of Sciences, Yerevan, Armenia). In addition to anatomic and taxonomic identification, the remains were examined for estimation of age, sex and recording of taphonomic markers that could indicate whether the animals were used as subsistence items, for aesthetic reasons, or ritual purposes. All bone measurements were taken according to von den Driesch (1976).

Faunal assemblages

The study of animal bone remains from the first and second Urartian layers is presented in this paper. Since the first and second Urartian layers are derived from different contexts, for the purposes of the research, each assemblage has been analysed separately. The first

Urartian layer is defined by the presence of the remains of residential buildings from the times of the rule of Argishti I, at the end of 8th century BC. The second Urartian layer consists of a floor with abundant Urartian artifacts and structural buildings which dates back to the beginning of the 7th century. During this latter period, the remains of a workshop of painters and other artisans were found on the slope of Erebuni Hill.

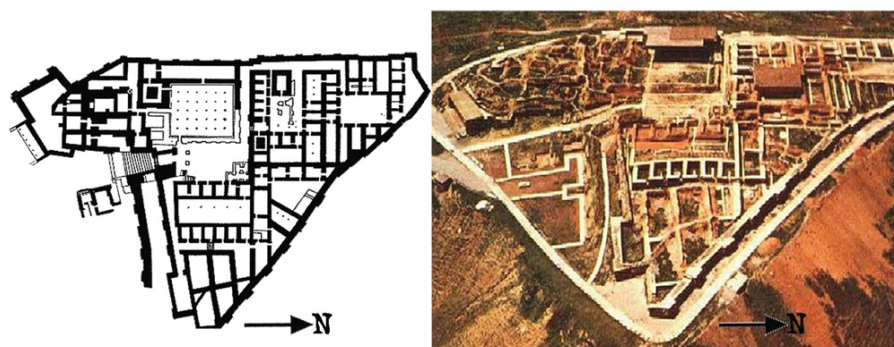


Fig. 10.2. Plan and aerial view of Erebuni.

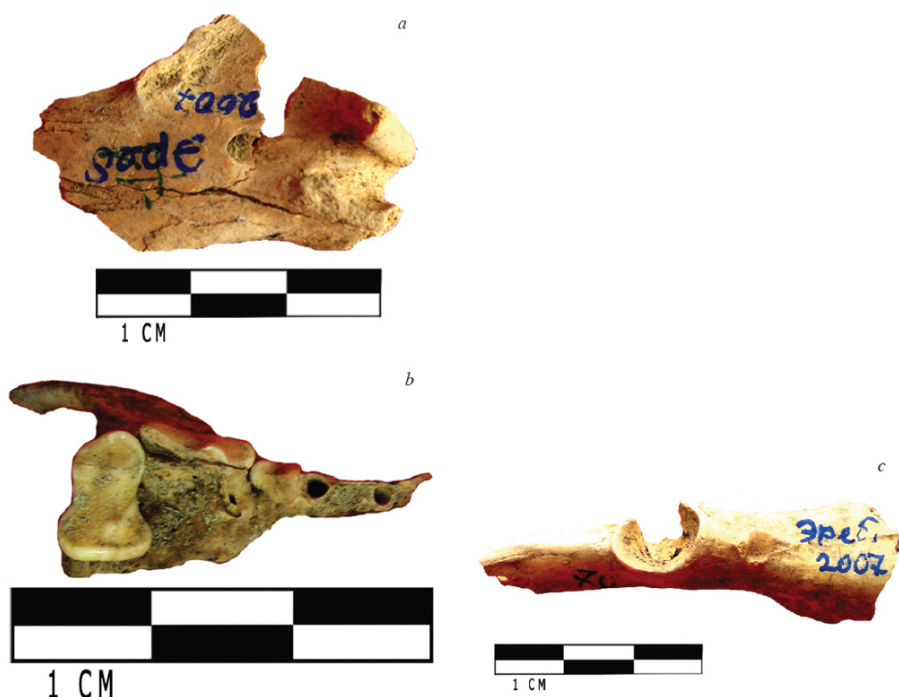


Fig. 10.3. a. Mandible fragment of badger (*Meles meles*); b. maxilla fragment of marten (*Martes foina*); c. hare pelvis fragment (*Lepus*

europaeus).

Table 10.1. Species distribution in the I Urartian layer of the Northern slope of Erebuni site, the Number of Identifiable Specimens (NISP) and percentage (%)

Taxa	NISP	%
Red deer (<i>Cervus elaphus</i>)	4	0,4
Roe deer (<i>Capreolus capreolus</i>)	1	0,1
Goitered gazelle (<i>Gazella subgutturosa</i>)	1	0,1
Mouflon (<i>Ovis orientalis</i>)	4	0,4
Badger (<i>Meles meles</i>)	1	0,1
Marten (<i>Martes foina</i>)	1	0,1
Hare (<i>Lepus europaeus</i>)	1	0,1
Bird (<i>Aves indet.</i>)	2	0,2
Cattle (<i>Bos taurus</i>)	230	25,1
Sheep/Goat (<i>Ovis aries/ Capra hircus</i>)	665	72,7
Pig (<i>Sus scrofa domesticus</i>)	1	0,1
Horse (<i>Equus caballus</i>)	2	0,2
Dog (<i>Canis familiaris</i>)	2	0,2
Total	915	100,0

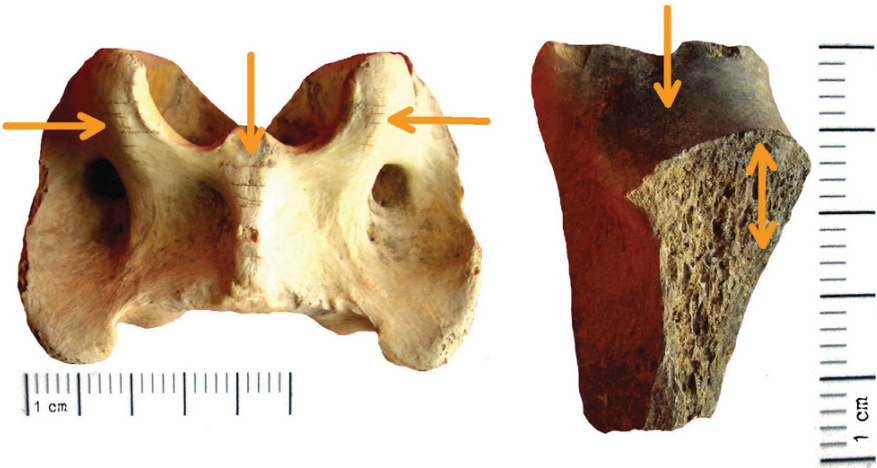


Fig. 10.4. Atlas of sheep with cut marks, and chopped and burned sheep radius fragment.

Table 10.2 Representation of the skeletal elements of cattle and sheep/goat.

Skeletal element	Cattle	Ovi-caprid
Cornu	3	1
Cranium	2	5
Maxilla		9

Mandibula	8	38
Dentes	34	54
Atlas		2
Axis		1
Vertebrae	55	128
Costae	60	224
Scapula	7	32
Humerus	4	31
Radius	6	12
Ulna	2	2
Metacarpus	2	15
Pelvis		29
Femur	1	14
Tibia	4	15
Astragalus	5	12
Calcaneus	5	13
Metatarsus	2	9
Phalanx 1	12	8
Phalanx 2	5	7
Phalanx 3	12	1
indet.fragment	1	
Total	230	662

First Urartian layer (end of 8th century BC)

The analysis of the faunal remains from this layer (NISP=915) provides evidence of a caprine-based subsistence economy (72.7%) (Table 10.1). Second after the small ruminants comes cattle (25.1%). Other domestic mammals include pig (0.1%), horse (0.2%) and dog (0.2%). Wild ungulates include red deer (0.4%), roe deer (0.1%), goitered gazelle (0.1%) and mouflon (0.4%) Wild small carnivores include badger and marten (only 0.1% each). A bone of a hare (0.1%) as well two from birds (0.2%) complete the faunal list (Table 10.1 and 10.3 a–c)

The bone assemblage from the first Urartian layer appears to be a primary consumption accumulation due to the extensive level of fragmentation, as well as the presence of cut marks and burned bones.

Domestic animals: All of the major domestic animals are present in the faunal assemblage. In the case of cattle and caprines, almost all of the skeletal elements were found (Table 10.2). On the other hand, only one astragalus from a pig was present in the assemblage. Horse remains include one astragalus and one calcaneus. A dog was identified from the fragments of a humerus and an ulna.

Out of 665 caprine bones, 30% have butchery marks and 60% are burned (Fig. 10.4). Among the cattle bones, 20% have taphonomic marks that include gnaw marks, burning and cut marks. None of the other bone remains exhibit visible taphonomic traces.

Wild animals: It is obvious, that the number of bone remains of game species is very small ([Table 10.3](#)). Nevertheless, their existence in the assemblage shows that, in addition to breeding domestic animals the inhabitants of Erebuni hunted ungulates for their meat, skin and horn/antlers, as well as small carnivores and hare for their meat, fur and fat (Meghlumyan & Martirosyan 1972). Not only were the Urartians good farmers, but their often successful wars with neighbouring empires most likely provided them with huge herds of domestic animals beyond their subsistence activities giving the possibility of future qualitative animal breeding.

Ageing and sexing

Only eight caprine skeletal remains could be aged. Using the method of Armitage it is identified that one horn core derived from a juvenile goat (less than 1 year old) (Armitage 1982). Two femora and a metacarpus belong to two different sub-adults (1–3 years old) based on epiphyseal fusion data (Silver 1969). Among the mandible fragments, one sub-adult (1–3 years old) and two adults (older than 3 years) could be identified using the dental eruption method. Although these data are not sufficient for judgements about the slaughtering strategies of the inhabitants, it seems that their products, such as meat, milk, wool and skin, were all exploited. Sex determination was only possible in the case of cattle where two metacarpal fragments belonged to a female and a male when the BFdm-Ddm and BFdm-BFdl sex determination method was applied ([Appendix 1](#)).

Metrical data

Measurements could be taken on very few bones, most of which were fragments ([Appendices 1 & 2](#)). Measurements were taken on sheep/goat *Trochlea humeri* (n=28) and the distal end of the tibia (n=11). This showed evidence of animals that had withers heights between 55cm and 70cm using Teichert's method (Teichert 1975). Due to the lack of measurements for other species there are no data available concerning their size. The measurements were then compared with those from other Urartian sites, namely from the Urartian (8th–7th centuries BC) and Late Urartian (7th–6th centuries BC) periods of Horom, and the Urartian periods of the Aramus site (8th–6th centuries BC).

Horom is situated in the northwest region of Armenia, in Shirak County, located 1700m above sea level. Excavations conducted there between 1990 and 1997 revealed that the site was occupied from the Kura-Arax until the Late Urartian periods. The Horom excavations

from 1990 to 1997 formed part of the framework of the International Program for Anthropological Research in the Caucasus (IPARC).

Aramus is located southwest of Yerevan, in Kotayq County, on a hilltop about 1500m above sea level. Findings from five excavation seasons showed that the settlement of the acropolis encompassed several phases covering the Iron Age (1200–500 BC) as well as the Early Medieval period. The Aramus excavations were a joint project between the University of Innsbruck (Austria), University of Yerevan (Armenia), Institute of Ethnography and Archaeology, ANAS (Armenia) and the Institute of Ancient History and Near Eastern Studies, ANAS (Armenia).

Table 10.3. Representation of the skeletal elements of wild species.

<i>Species/ Skeletal element</i>	<i>Red deer</i>	<i>Roe deer</i>	<i>Gazelle</i>	<i>Mouflon</i>	<i>Badger</i>	<i>Marten</i>	<i>Hare</i>
Mandible					1		
Maxilla						1	
Humerus				1			
Radius	1						
Pelvis							1
Tibia	2	1	1	2			
Calcaneus				1			
III phalanx	1						

Table 10.4. Comparative Limits (minimum - maximum) of measurements of Sheep/Goat bones from Erebuni, Horom and Aramus.

<i>Scapula</i>	n	GLP	LG
Erebuni (U1)	18	30.8–36.7	24.0–30.0
Horom (U)	2	37.7–38.1	29.7–30.0
Aramus	1	31.9	23.8

<i>Humerus</i>	n	BT	SD
Erebuni (U1)	28	25.0–34.5	13.3–16.8
Horom (U/LU)	4	30.1–33.4	–
Aramus	1	29.4	–

<i>Radius</i>	n	Bp	Bd
Erebuni (U1)	7	29.5–34.8	26.8–32.3
Horom (U)	1	32.5	–
Aramus	1	33.5	30.2

<i>Metacarpus</i>	n	Bp
Erebuni (U1)	8	21.4–26.3
Horom (U/LU)	6	22.2–25.2
Aramus	1	22.9

<i>Tibia</i>	n	Bd	SD
Erebuni (U1)	11	25.0–29.0	13.0–17.5
Aramus	3	25.8–29.8	–

<i>Metatarsus</i>	n	Bp
Erebuni (U1)	7	18.5–22.5
Horom (U/LU)	3	20.8–22.8

<i>Calcaneus</i>	n	GL
Erebuni (U1)	7	49.0–61.1
Horom (U)	4	57.6–64.1
Aramus	3	57.1–57.2

<i>Astragalus</i>	n	GLl	GLm	Bd	DI	Dm
Erebuni (U1)	12	24.7–31.5	22.7–30.5	15.7–20.8	13.4–17.6	14.0–18.8
Horom (U)	5	25.3–34.5	24.5–32.7	15.9–24.6	13.2–19.8	–
Aramus	3	26.3–30.0	25.2–29.2	16.7–19.0	14.2–17.0	14.5–17.0

<i>I Phalanx</i>	n	GLpe	Bp	Bd	SD
Erebuni (U1)	7	33.2–37.8	11.8–13.0	11.0–12.7	10.0–11.0
Horom (U/LU)	3	35.8–41.3	12.3–12.7	11.3–12.1	9.6–10.8
Aramus	8	32.7–37.2	11.2–13.5	10.6–12.9	9.3–11.0

<i>II Phalanx</i>	n	GL	Bp	Bd	SD
Erebuni (U1)	7	20.5–23.3	10.8–13.0	8.3–10.7	7.8–9.6
Aramus	5	20.4–24.8	9.4–12.3	7.1–9.6	6.5–8.8

Table 10.5. Comparative Limits (minimum - maximum) of measurements of Cattle bones from Erebuni, Horom and Aramus.

<i>Scapula</i>	n	GLP	LG
Erebuni (U1)	3	60.0–61.6	51.5–53.0
Horom (U/LU)	11	61.6–68.5	46.4–54.5

<i>I phalanx (anterior/posterior)</i>	n	GLpe	Bp	Bd	SD
Erebuni (U1)	3	49.5–64.8	22.0–34.5	22.4–32.2	19.5–29.4
Horom (U)	39	48.1–69.3	24.4–39.2	21.9–42.4	20.2–33.9
Aramus	6	49.0–57.0	22.9–31.4	22.0–29.0	19.4–26.0

<i>II phalanx (anterior/posterior)</i>	n	GL	Bp	Bd	SD
Erebuni (U1)	4	37.5–44.0	29.2–31.6	23.0–25.8	24.0–26.2
Horom (U)	10	32.5–48.9	24.5–36.0	19.5–32.3	18.2–29.2
Aramus	6	37.4–40.3	23.4–29.4	20.8–24.7	19.5–24.3



Fig. 10.5. Coloured bone fragments from the Urartian period 2 layer



Fig. 10.6. Calf femur, before the colour experiment.



Fig. 10.7. a. Ochre coloured and cooked calf femur, with separated diaphysis and epiphysis; b. ochre coloured and cooked femoral diaphysis, showing a high level of porosity.



Fig. 10.8. The 'produced' paint was utilised to colour a wall fragment.

These comparisons show that during the Urartian period there were no significant differences among the sizes of the animals, even when living in different geographical zones, such as was the case of Horom. The minor differences between some measurements seem to be the result of either the size of the sample (e.g. cattle bones from Erebuni are far fewer than at Horom) or the individual variation of animals, or a combination of both factors ([Tables 10.4 & 10.5](#)).

Second Urartian layer (beginning of the 7th century BC)

The assemblage of 235 remains from the second Urartian layer showed evidence of a far higher level of fragmentation than was the case for the first layer. The context is also different as the bone remains were found in a supposed workshop environment. These bone fragments were not only coloured but their natural texture had changed as well ([Fig. 10.5](#)).

Next to the bone remains, pieces of ochre, along with a dark blue crystalline paint and white chalk, were found. It is believed that these materials were used for colouring walls and drawing frescos. The intensive level of fragmentation and fragile texture of the bones made the identification of species impossible. The bone fragments were very

porous and crystallised and apparently all were lacking collagen. From such data, we have assumed that the bones found in this level had all been cooked for a prolonged period (Roberts et al. 2002). They might have been the remains of animals consumed as meat, that were later used secondarily as a source of a natural fixative for the paint. The peculiar nature of this deposit did not allow us to incorporate them into the general analysis of the bone remains.

Coloured bones: an experiment

To confirm the possible use of these bones as aids in painting frescos, and to locate their specific role in the process, an experiment was conducted. The femur of a modern juvenile calf (760g) was split into two parts from the middle of the diaphysis (Fig. 10.6) and one litre of water was added to it. It was boiled on an electrical stove at 200°C for 30 minutes with the temperature set at 100°C. After one and a half hours of boiling, the bone epiphyses separated, but boiling in these conditions continued for a further ten hours, with one litre of water added each hour. Later, all the bone fragments stayed in obtained suspension for 24 hours at +8°C, in order to ascertain the metabolic activities between the bone and the liquid. Then, 50g of a natural yellow ochre pigment was added to the suspension and warmed till 50°C. The pigment dissolved in the solution and gave an orange–yellow tint to the bone. After such a treatment the bone fragments became highly porous and fragile (Fig. 10.7a & b). The coloured suspension remained for another 24 hours at +8°C and was filtered afterwards. The result of this experiment was that a yellow coloured homogeneous paint was produced, which could be used, for example, for painting a wall (Fig. 10.8). This experimental method was established by the first author using published data from Denys (2002), Andrews (1995), Alhaique (1997) and Lyman (1994).

The reason for using bones in paint manufacture is due to the characteristics of bone collagen. When collagen is boiled in water, the three tropocollagen strands separate into globular, random coils, which hydrolyse partially and produce gelatin. This serves as a natural solvent, and once it has dried, it functions as a perfect fixer and preservative. Ochre is a natural pigment whose colouring agent is iron (III) oxide (Fe_2O_3). Yellow ochre is iron (III) oxide hydrate ($\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$). It is only partially soluble in water, but dissolves well in gelatin. Thus, we have here a good combination of a solvent–fixer–preservative, this being the gelatine, and a solute represented by the pigment. This combination produces a valid paint for the frescos.

It is known that the Romans also used animal bones in both glue

and paint production (Peters 1998). Much later, from the 18th century (or earlier) until the middle of the 20th century, bone glue was the main fixative for furniture. Nowadays, animal bones are a source of natural glue used in artwork, cabinet making and other branches of technology that require environmentally friendly and harmless products.

Let us now consider the wider context of how animals appear in Urartian art and inscriptions to understand the role of human-animal relations in Urartian society.

Animal representations

Animal representations add to our interpretation of the role of animals in Urartian society. In this context, the site of Erebuni is unique because of the diverse range of objects found there which incorporate animal depictions. These include impressive wall paintings (frescoes), military equipment, as well as household and personal objects (Hovhannisyan 1973). It is remarkable that all of the animals depicted on these objects, as well as those mentioned in Urartian inscriptions, were present in the archaeozoological assemblages.

Two major types of depictions can be considered here: ritual and social. A special ritual role was given to animals with which man had a difficult relationship or with animals that he could not tame easily, such as the lion and the bull. Both animals were depicted frequently together with Urartian divinities, who were carried by these powerful creatures on their backs (Fig. 10.9). In depictions where a lion and bull are present without any gods, they constitute symbols of power. Both lions and bulls were considered to be protected by the Gods, and thus were used as protective symbols on military garments and equipment (e.g. helmets, belts, etc.). The depiction of the lion and the bull on Urartian art is always executed with special care and mastery. Other animals present in ritual images include goats, birds or fishes. Social depictions of the Urartians include hunting and agricultural scenes, as well as depictions of war against powerful enemies. They provide a very realistic insight into daily life (Figs 10.10 and 10.11).



Fig. 10.9. The god Haldi, standing on the back of a lion. This depicts a ritual scene and is a fragment of the Erebuni fresco.



Fig. 10.10. Hunting scene with leopard and bull. This depicts a social scene and is a fragment of the Erebuni fresco.

The animal taxa depicted on either architectural elements and/or objects includes: Asian lion, leopard, red deer, roe deer, hare, aurochs/cattle, sheep, goat, horse, dog, and different species of birds, snakes and fishes.

The relationship between man and specific animals was not only reproduced in wall paintings, but also in statues, furniture, domestic and ritual vessels (Fig. 10.12), horse harnesses, chariot decorations, seals (Fig. 10.13), personal adornments, belts, helmets and shields.

Animals in Urartian inscriptions

Animals are also present in many Urartian inscriptions. These describe sacrifices specifically mentioning animals used in sacrificial ceremonies. Of great value is the Meher Kapisi inscription, which provides the most detailed information on the official religion of the Urartian Kingdom. It was found in the Lake Van region (present day Turkey) (Table 10.6). Depending on the hierarchical order, the exact quantity of sacrificial animals is given in this inscription. For instance, it says that each year 17 cattle, 6 lambs, and 34 sheep are sacrificed to

the state god Haldi. The animals known, so far, to have been chosen for sacrifice, according to the translated inscriptions, are aurochs/cattle, sheep, goat and water buffalo (Belli 1999).

Conclusion

Animals played an important role in Urartian life. They contributed not only to diet and the general subsistence economy, but also to other cultural and religious aspects. Continuous wars between the Urartians and their neighbouring empires promoted the mixing of breeds of various domesticated animals. This resulted in new breeds that ultimately raised the quality of animal products.



Fig. 10.11. Horse painting. This depicts a social scene and is a fragment of the Erebuni fresco.

Table 10.6. Comparative table of the animals due to bone remains, architectural and object remains and the Meher Kapisi inscription.

<i>Animals identified from the bone remains of Erebuni excavations (2003–2007)</i>	<i>List of animals due to architectural and object remains</i>	<i>List of sacrificial animals due to Mher Kapisi inscription</i>
Red deer (<i>Cervus elaphus</i>)	Red deer (<i>Cervus elaphus</i>)	
Roe deer (<i>Capreolus capreolus</i>)	Roe deer (<i>Capreolus capreolus</i>)	
Gazelle (<i>Gazella subgutturosa</i>)		
Mouflon (<i>Ovis orientalis</i>)		
	Asian lion (<i>Panthera leo persica</i>)	
	Leopard (<i>Panthera pardus</i>)	
Badger (<i>Meles meles</i>)		
Marten (<i>Martes foina</i>)		
Hare (<i>Lepus europaeus</i>)	Hare (<i>Lepus sp.</i>)	
Bird (<i>Aves</i>)	Bird (<i>Aves</i>)	
	Snake (<i>Serpentes</i>)	
	Fish (<i>Pisces</i>)	
Cattle (<i>Bos taurus</i>)	Aurochs / Cattle (<i>Bos sp.</i>)	Aurochs /cattle (<i>Bos sp.</i>) Water buffalo (<i>Bos bubalis</i>)
Sheep (<i>Ovis aries</i>)	Sheep (<i>Ovis sp.</i>)	Sheep (<i>Ovis sp.</i>)
Goat (<i>Capra hircus</i>)	Goat (<i>Capra sp.</i>)	Goat (<i>Capra sp.</i>)
Pig (<i>Sus scrofa domesticus</i>)		
Horse (<i>Equus caballus</i>)	Horse (<i>Equus sp.</i>)	
Dog (<i>Canis familiaris</i>)	Dog (<i>Canis familiaris</i>)	

When bringing together all of these above data, we have a much clearer vision of the role that animals played in the life of the Urtians, as well as of human-animal relations in Urtian society. Through the comparisons of the species identified at the Erebuni, Horom and Aramus excavations, the animal depictions and the animals mentioned in Urtian inscriptions, we can see that some of the animals, such as aurochs/cattle, sheep and goat, are present in all three categories of evidence (Table 10.6). Other animals, such as horses and dogs, as well as red deer, roe deer and hare, were identified from the Erebuni and other Urtian bone assemblages and are also depicted on Urtian finds.

This paper adds to our growing knowledge about the archaeozoology of Armenia, supplementing previous work carried out by Gauthier & Vanderbruaene (1997), Küchelmann et al. (2006), Manaseryan (2006) and Obermaier (2006) for contemporary and later periods.

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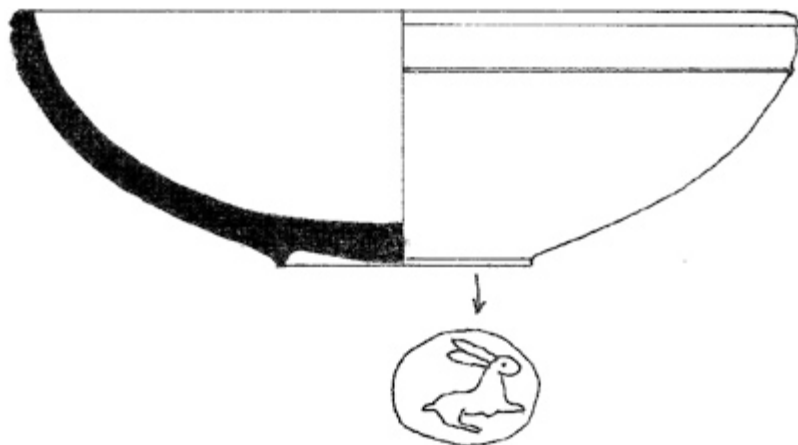


Fig. 10.12. Hare depiction on the outer base of a ceramic bowl from Erebuni.



Fig. 10.13. Bird depiction on a seal from Erebuni.

Finally, this paper would not have been published without the help and support of Dr Marjan Mashkour, Dr Mark Beech and Dr Arturo Morales who reviewed and made many valuable comments and changes in this paper. Thank you!

Notes

- ¹ The authors are grateful to Dr Felix Ter-Martirosov and his team for providing bone assemblages for research after each excavation season.
- ² We were not able to weigh bone remains at all stages of the study, therefore weight will not be discussed in this paper.

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Appendix 10.1. Measurements of Cattle bone remains

<i>Scapula</i>		
	GLP	LG
Erebuni (U1)	60.5	52.9
Erebuni (U1)	60.0	51.5
Erebuni (U1)		35.0*
Erebuni (U1)	61.6	53.0
<i>average</i>	<i>60.7</i>	<i>48.1</i>

<i>Humerus</i>		
	Bd	BT
Erebuni (U1)	67.0	61.7
Erebuni (U1)	78.0	68.5

<i>Radius</i>		
	Bp	Fp
Erebuni (U1)	79.0	72.0
Erebuni (U1)	73.0	67.2
Erebuni (U1)	67.0	60.6

<i>Ulna</i>		BPC
Erebuni (U1)		41.0
Erebuni (U1)		40.2

<i>Metacarpus</i>		
	Bd	
Erebuni (U1)	59.0	M**
Erebuni (U1)	55.3	F***

<i>Tibia</i>		Bd
Erebuni (U1)		51.0
Erebuni (U1)		56.5
Erebuni (U1)		66.0

*Juvenile.

**Masculine.

***Feminine

<i>Metatarsus</i>		Bd
Erebuni (U1)		71.5

<i>Calcaneus</i>	GLI	GLm	Bd	DI	Dm
Erebuni (U1)	64.6	60.3	45.0	35.5	34.8
Erebuni (U1)	54.5	49.3	36.7	30.3	28.4
Erebuni (U1)	59.8	53.8	38.0	33.0	28.0

I Phalanx anterior/posterior

	GLpe	Bp	Bd	SD
Erebuni (U1)	64.3	32.2	29.8	26.9
Erebuni (U1)	64.8	34.0	30.2	28.8
Erebuni (U1)	56.8	27.0	24.9	23.0
Erebuni (U1)	58.2	31.0	29.0	28.0
Erebuni (U1)	55.0	27.8	24.5	23.8
Erebuni (U1)	62.8	34.3	32.2	29.4
Erebuni (U1)	49.5	22.0	22.4	19.5
Erebuni (U1)	54.6	23.5	22.7	21.0
<i>average</i>	<i>58.3</i>	<i>29.0</i>	<i>27.0</i>	<i>25.1</i>

II Phalanx anterior/posterior

	GL	Bp	Bd	SD
Erebuni (U1)	37.5	29.2	23.3	24.3
Erebuni (U1)	37.9	29.8	23.0	24.0
Erebuni (U1)	41.2	30.3	23.8	24.3
Erebuni (U1)	44.0	31.6	25.8	26.2
<i>average</i>	<i>40.2</i>	<i>30.2</i>	<i>24.0</i>	<i>24.7</i>

III Phalanx anterior/posterior

	Ld	DLS
Erebuni (U1)	53.4	69.7
Erebuni (U1)	49.6	60.5
Erebuni (U1)	49.8	62.2
Erebuni (U1)	49.2	62.5
Erebuni (U1)	48.5	61.0
Erebuni (U1)	55.6	70.7
Erebuni (U1)	57.6	76.8
Erebuni (U1)	47.7	63.0
Erebuni (U1)	50.6	64.7
Erebuni (U1)	54.9	81.6
<i>Average</i>	<i>51.7</i>	<i>67.3</i>

Appendix 10.2. Measurements of Sheep/Goat bone remains

<i>Mandible</i>	3	6	11	12	13	10	15a	15b	15c
Erebuni (U1)	51.0	134.0	38.7	64.0	66.5		34.7	25.2	17.0
Erebuni (U1)						20.6/8.0			
Erebuni (U1)							41.6	23.4	16.0
Erebuni (U1)								30.2	18.3
Erebuni (U1)							36.5		
Erebuni (U1)								22.5	16.0
Erebuni (U1)								20.5	14.7
Erebuni (U1)								25.0	16.5
Erebuni (U1)									15.7
Erebuni (U1)							34.1		
Erebuni (U1)								23.9	16.0
Erebuni (U1)								24.2	17.0

<i>Atlas</i>	GL	BFcd
Erebuni (U1)	41.6	38.8
Erebuni (U1)	42.5	39.5

<i>Epistropheus</i>	LCDe	BFcr	SBV
Erebuni (U1)		37.9	20.7
Erebuni (U1)		36.7	21.0
Erebuni (U1)	56.0	42.5	23.2
Erebuni (U1)		42.3	25.0
<i>average</i>		39.9	22.5

<i>Scapula</i>	GLP	LG
Erebuni (U1)	35.4	27.8
Erebuni (U1)	33.0	25.8
Erebuni (U1)	36.7	27.5
Erebuni (U1)	33.2	28.0
Erebuni (U1)	35.0	27.5
Erebuni (U1)	34.8	27.0
Erebuni (U1)	36.0	27.6
Erebuni (U1)	30.8	24.0
Erebuni (U1)	36.0	30.0
Erebuni (U1)	36.7	29.5
Erebuni (U1)	33.0	27.0
Erebuni (U1)	33.0	26.0
Erebuni (U1)	32.5	27.5
Erebuni (U1)	31.0	24.0
Erebuni (U1)	33.0	27.0
Erebuni (U1)	30.8	24.0
Erebuni (U1)	31.6	25.0
Erebuni (U1)	32.3	26.0
<i>average</i>	<i>33.6</i>	<i>26.7</i>

<i>Humerus</i>	GL	Bp	Bt	SD
Erebuni (U1)			31.0	16.8
Erebuni (U1)	141.0	40.6	34.5	15.2
Erebuni (U1)	137.7	38.8	30.3	16.0
Erebuni (U1)			31.5	
Erebuni (U1)			31.3	16.0
Erebuni (U1)			30.8	
Erebuni (U1)			28.5	
Erebuni (U1)			31.0	
Erebuni (U1)		36.2		14.2
Erebuni (U1)			31.3	14.8
Erebuni (U1)			25.0	13.3
Erebuni (U1)			28.5	14.0
Erebuni (U1)			30.3	15.5
Erebuni (U1)			28.3	14.4
Erebuni (U1)			30.7	
Erebuni (U1)			25.5	12.2
Erebuni (U1)			29.0	
Erebuni (U1)			29.8	15.4
Erebuni (U1)			31.5	
Erebuni (U1)			30.5	14.2
Erebuni (U1)			28.7	
Erebuni (U1)			30.6	
Erebuni (U1)			33.2	
Erebuni (U1)			32.8	
Erebuni (U1)			34.0	
Erebuni (U1)			29.2	
Erebuni (U1)			32.2	
Erebuni (U1)			26.2	
Erebuni (U1)			31.7	
<i>average</i>			30.3	14.8

<i>Radius</i>	GL	Bp	Bd	SD
Erebuni (U1)		31.6		
Erebuni (U1)		34.8		
Erebuni (U1)			31.3	
Erebuni (U1)		30.2		
Erebuni (U1)				14.4
Erebuni (U1)		29.5		
Erebuni (U1)		32.1		
Erebuni (U1)			26.8	
Erebuni (U1)			32.3	
Erebuni (U1)	153.2	34.2	32	17.5
Erebuni (U1)		33.4		
<i>average</i>		32.3	30.6	

<i>Ulna</i>	LO	BPC
Erebuni (U1)	37.8	18.5
Erebuni (U1)		20.5

<i>Metacarpus</i>	Bp	Bd
Erebuni (U1)	25.0	
Erebuni (U1)	23.5	
Erebuni (U1)	21.4	
Erebuni (U1)	22.2	
Erebuni (U1)	25.5	
Erebuni (U1)	25.0	
Erebuni (U1)		25.0
Erebuni (U1)		23.0
Erebuni (U1)	26.3	
Erebuni (U1)		22.5
Erebuni (U1)	24.0	
<i>average</i>	24.1	

<i>Femur</i>	GL	Bp	Bd	SD
Erebuni (U1)	179.0	47.5	40.5	17.8
Erebuni (U1)		40.8		14.5
Erebuni (U1)		42.6		13.6
Erebuni (U1)		50.0		
Erebuni (U1)			38.6	
Erebuni (U1)			35.5	
Erebuni (U1)		42.0		
Erebuni (U1)			42.0	
Erebuni (U1)		46.0		
Erebuni (U1)			37.0	
Erebuni (U1)	162.0	42.0	35.5	14.5
<i>average</i>		44.4	38.2	15.1

Tibia

	Bp	Bd	SD
Erebuni (U1)		29.0	17.5
Erebuni (U1)			13.0
Erebuni (U1)		26.3	
Erebuni (U1)		29.0	
Erebuni (U1)		26.0	14.0
Erebuni (U1)		25.0	14.5
Erebuni (U1)		26.0	14.0
Erebuni (U1)		25.0	
Erebuni (U1)		26.0	
Erebuni (U1)		26.7	14.0
Erebuni (U1)		28.2	
Erebuni (U1)		27.0	
Erebuni (U1)	39.2		13.5
<i>average</i>		26.7	14.4

<i>Metatarsus</i>	Bp
Erebuni (U1)	18.5
Erebuni (U1)	20.5
Erebuni (U1)	22.0
Erebuni (U1)	19.3

Erebuni (U1)	20.4
Erebuni (U1)	22.5
Erebuni (U1)	21.7
<i>average</i>	<i>20.7</i>

<i>Calcaneus</i>	GL
Erebuni (U1)	56.0
Erebuni (U1)	49.0
Erebuni (U1)	60.3
Erebuni (U1)	56.7
Erebuni (U1)	55.6
Erebuni (U1)	52.4
Erebuni (U1)	61.1
<i>average</i>	<i>55.9</i>

<i>Astragalus</i>	GLl	GLm	Bd	DI	Dm
Erebuni (U1)	30.5	29.0	20.5	16.7	17.5
Erebuni (U1)	29.3	28.6	19.2	16.5	15.9
Erebuni (U1)	29.0	28.8	18.5	16.6	17.0
Erebuni (U1)	24.7	22.7	16.0	13.4	14.0
Erebuni (U1)	25.5	23.7	15.7	14.0	16.3
Erebuni (U1)	27.6	25.8	17.5	14.5	16.7
Erebuni (U1)	31.0	30.0	20.5	17.5	18.0
Erebuni (U1)	29.2	27.3	16.8	15.5	16.0
Erebuni (U1)	31.5	30.5	20.6	16.7	18.8
Erebuni (U1)	28.0	26.4	18.9	15.6	16.8
Erebuni (U1)	25.0	24.3	17.3	13.6	14.8
Erebuni (U1)	31.2	29.2	20.8	17.6	18.7
<i>average</i>	<i>28.5</i>	<i>27.2</i>	<i>18.5</i>	<i>15.7</i>	<i>16.7</i>

<i>I Phalanx anterior/posterior</i>				
	GLpe	Bp	Bd	SD
Erebuni (U1)	33.2	11.8	11.0	10.2
Erebuni (U1)	37.8	12.9	12.7	10.6
Erebuni (U1)	34.9	11.9	11.0	10.0
Erebuni (U1)	35.3	12.7	11.8	10.8
Erebuni (U1)	35.3	13.0	11.8	11.0
Erebuni (U1)	37.5	12.8	11.8	10.7
Erebuni (U1)	36.7	13.0	12.2	10.8
<i>average</i>	<i>35.8</i>	<i>12.6</i>	<i>11.8</i>	<i>10.6</i>

<i>II Phalanx anterior/posterior</i>				
	GL	Bp	Bd	SD
Erebuni (U1)	21.2	10.8	8.3	7.9
Erebuni (U1)	21.3	11.3	8.6	7.8
Erebuni (U1)	22.3	12.7	10.0	9.6
Erebuni (U1)	20.7	13.0	10.7	9.5
Erebuni (U1)	20.5	11.3	9.0	8.3
Erebuni (U1)	23.3	11.8	9.3	8.0
Erebuni (U1)	22.8	11.3	9.3	7.8
<i>average</i>	<i>21.7</i>	<i>11.7</i>	<i>9.3</i>	<i>8.4</i>

Part 3

Examples of animal exploitation on
urban sites during the Bronze Age

11. Animal exploitation from the Bronze Age to the Early Islamic period in Haftavan Tepe (Western Azerbaijan-Iran)

Fatemeh Azadeh Mohaseb and Marjan Mashkour

A rich documentation on the subsistence economy is provided for the long sequence of occupation of Haftavan Tepe in Western Azerbaijan between the Bronze Age to the Islamic period with a set of novel radiocarbon dates for this site. In all periods, Bovines constitute the bulk of the assemblage even if Ovicaprines play an important role for this agropastoral economy where hunting remains a marginal activity. On a regional scale, the pattern observed in Haftavan Tepe seems to express the same global tendency for northern Iran compared to adjacent sites in Turkey where the exploitation of Suids is more characteristic.

Keywords Archaeozoology, Haftavan Tepe, Bronze Age, Radiocarbon dating, Kill-off patterns.

Introduction

Haftavan Tepe is one of the largest sites of Azerbaijan in Iran, excavated during the '70s where the archaeozoological data for the Bronze Age are well represented. Haftavan Tepe has yielded one of the largest faunal assemblages in western Azerbaijan and thus constitutes a reliable source of information for the understanding of the subsistence economy of this part of the Iranian Plateau during more than two millennia.

The aim of this paper is to present the results of the faunal assemblage of Haftavan Tepe recovered during ten years (1968–1978),

stored in the basement of the British Council at British Institute of Persian Studies in Tehran and literally rediscovered in the late '90s. Also a small part of the assemblage was housed at the University of Manchester that was transferred to the Natural History Museum of Paris. After 30 years, this large faunal assemblage of Haftavan Tepe could be entirely studied within a PhD programme (Mohaseb 2012).

Haftavan Tepe is located in the middle of the small plain of Salmas, in the northwestern part of Lake Urmia in the province of Western Azerbaijan in Iran. The area of the mound extends over 550m from east to west and up to 400m from north to south, with a maximum height of about 25m above the virgin soil. Haftavan Tepe is one of the largest prehistoric sites around the lake (Burney 1972). The excavation of the mound of Haftavan took place between 1968 and 1978 under the direction of Charles A. Burney, sponsored by the University of Manchester and the support of the British Academy and the Calouste Gulbenkian Foundation (Burney 1973).

Chronology framework

The large area covered by Haftavan settlement indicates the local importance of the site as the center of a small but well watered and extremely fertile plain (Burney 1970). The archaeological evidences in Haftavan Tepe show clear cultural contacts and influences with both the south, Hasanlu (Danti 2013) and its surroundings, a multiperiod site occupied from the Neolithic to the Islamic period and the north, Trans-Caucasian region (Burney 1970; Edwards 1981, 1986; Danti 2013; Summers 1982; 2013) ([Fig. 11.1A](#)).

The excavation at Haftavan Tepe was carried out during four seasons. Eight levels of occupation were exposed and yielded architectural remains dated from the Early Trans-Caucasian period through to the Sasanian times. In his third report, Burney stated that several large flattish stones on top of the mound belong perhaps to the very early Islamic period (Burney 1973). The results of our dating also demonstrate the presence of remains in the Early Islamic period. The archaeological remains show cultural continuity during the occupation with no major interruptions (Burney 1973). Several trenches (about 33) were investigated during ten years of excavation ([Fig. 11.1B](#)).

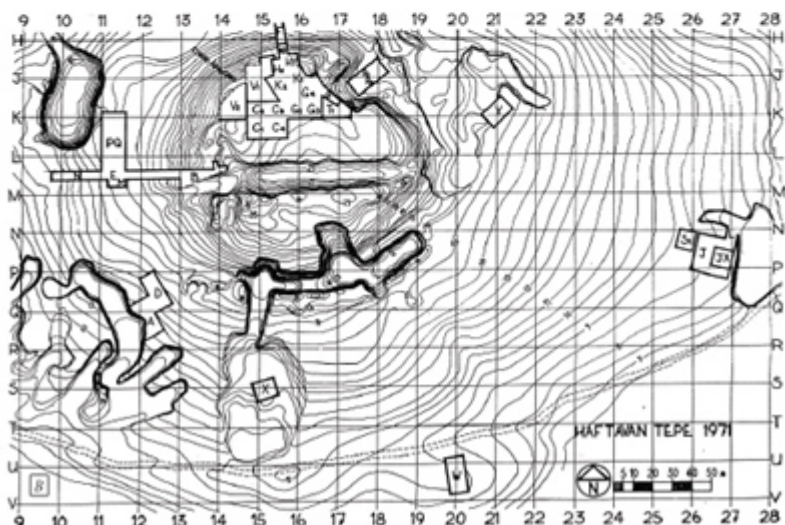


Fig. 11.1. A: Geographical location of Haftavan Tepe in the Urmia basin and the localisation of comparative sites in Northwest of Iran and southeast of Turkey. B: Trenches investigated during ten years of excavation in the mound of Haftavan Tepe (Burney 1973, 154).

The only documents available for the chronology of the site were the reports of Burney during the excavation (Burney 1973), which is characterised by eight main cultural periods (Table 11.1). Before the present work, two radiocarbon dates for Haftavan Tepe were known, processed by Dr Mahdavi in Tehran. One of them belongs to the Achaemenid period with a mean radiocarbon date of 492 BC (Burney 1975) and the other one belongs to the Middle Bronze Age context with a mean radiocarbon date of 1772 BC (Edwards 1983).

At the beginning of the study, many problems appeared in relation mainly with contextualising the faunal remains. Because of poor storage conditions of the archaeological material during the last 30

years, many bone bags contained either no archaeological information or with information not reported in the publications. This is surprisingly the case for some of the levels in otherwise known trenches (trench JX level 8, trench X3 level 1, trench TT6D level 1B, trench C2 levels 9, 10, 12, 14, 16, 18, 19, 22, 24, 25, 29, 32, 34 and trench C4 level 6) or for the whole trench (C7, ZXR1, TX1, TX2).

Table 11.1. The chronology of Haftavan Tepe after Burney (1973)

<i>Haftavan Tepe</i>	<i>Cultural periods</i>	<i>Date</i>
Haftavan I	Sasanian and later	AD 224–651
Haftavan II	Median, Achaemenid and Parthian	728 BC–AD 224
Haftavan III	Urartian	800–600 BC
Haftavan IV	Iron II	1000–800 BC
Haftavan V	Iron I	1200–1000 BC
Haftavan VI	Middle and Late	1800–1200 BC
Haftavan VII	Early Trans-Caucasian III	2300–1800 BC
Haftavan VIII	TransCaucasian	3rd quarter 3rd millenium BC

Because of all these discrepancies and the important quantity of data that was about to be lost, we decided to develop a direct AMS radiocarbon dating program of mammalian bones on some of these undocumented assemblages. Among the ten trenches quoted above, six trenches with quantitatively important data were selected for radiocarbon dating processed by the Radiocarbon Chrono Centre of the Queen’s University at Belfast ([Table 11.2A](#)).

According to these results, the sample *JX/8/n4* falls into the Early Bronze Age. The samples from *X3/1* and *BB1/1/8* belong to the Middle and Late Bronze Age. The sample *TT6D/1B* belongs to the Iron Age, the sample *TX2/1/1* to the Sasanian period and the sample *TX1/n505* refers clearly to the Early Islamic period. Although the date is clearly Islamic, even if one considers the inferior margin (i.e. AD 661), it is important to remind that Azerbaijan was invaded only 20 years before (Minorsky 1991) and it is most probable that the beliefs and ways of life have not yet changed drastically ([Table 11.2B](#)).

In the middle of the 3rd millennium BC (period VIII) Haftavan was a very important urban settlement. During the long and peaceful period of VII, there is a low representation of potteries and archaeological remains and thus we don’t have much information about this period (Burney 1972). The period VI is the longest and the most important in the history of Haftavan Tepe. Probably, the settlement of Haftavan VI reached its maximum size because the archaeological remains were discovered from east to west extremities of the mound. There are the remains of a perimeter wall around the

city of Haftavan during this period. Haftavan seems to be occupied only partly during the Iron Age I (Burney 1970). During the 10th and 9th centuries BC, the Urartian period, the city regained its urban importance, which continued to the end of this period. At the end of Achaemenid Empire, the settlement was temporarily abandoned. The long occupation of the city of Haftavan came to an end about the end of the Sasanian, or perhaps at the beginning of the Islamic period (Burney 1970; 1973).

Table 11.2. A: New radiocarbon dates from Haftavan Tepe processed by the radiocarbon Chrono Centre of the Queen’s University at Belfast; B: new chronological attributions used for the faunal analysis.

A

Sample ID	TX1/n505	TX2/1/1	TT6D/1B	BB1/1/8	X3/1	JX/8/n4
Trench	TX1	TX2	TT6D	BB1	X3	JX
Species	Caprini	Suid	Caprini	Small ruminant	Suid	Caprini
Bone sample	Radius	Radius	Radius	Radius	Mandible	Metacarpus
UBA No	UBA-9987	UBA-9988	UBA-9986	UBA-9985	UBA-9989	UBA-9990
Radiocarbon determination (BP)	1302±22	1490±23	2791±38	3210±35	3296±25	3562±26
Radiocarbon date (2σ)	cal AD 661–725	cal AD 540–631	1027–836 cal BC	1534–1413 cal BC	1630–1504 cal BC	1978–1874 cal BC
Probability (%)	67	100	99.6	98	100	87

B

Haftavan Tepe	Cultural periods	Date
Haftavan EI	Early Islamic period	AD 661–725
Haftavan MAPS	Median, Achaemenid, Parthian & Sasanian	728 BC–651 AD
Haftavan IA	Iron Age I & II	1200–800 BC
Haftavan MLBA	Bronze Age, period VI	1800–1200 BC
Haftavan ETC III	Bronze Age, period VII	2300–1800 BC

The faunal remains of Haftavan Tepe are not distributed evenly for all the cultural periods present at the site. For instance there are no remains from the Urartian (III) and the Transcaucasian (VIII), two important cultural periods for this region. We analyse the faunal remains within five cultural periods according to the amount of remains for each of them. The latest is the Early Islamic period (EI), which produced about 1190 remains. The small size of the remains of Period I led us to pool it together with period II and make the MAPS (Median, Achaemenid, Parthian and Sasanian) periods (N=1440). Similarly we pooled together those of period IV with period V and made the Iron Age (IA), which contained about 230 remains. The most important period in the settlements of Haftavan Tepe and, of course, in the analysis of the faunal remains (N=10,900), is the Middle and

Late Bronze Age (MLBA). Finally the earliest period, which contained the faunal remains at this site (N=420), is the Early Bronze Age (EBA). We will see below if any evolution in the subsistence is visible or not.

Bone preservation

The faunal assemblage of Haftavan Tepe belongs to consumption refuse. Traces of human activity, butchery marks and cooking traces (burning) are visible on many of the bones (Fig. 11.2).

The study of the faunal remains (Barone 1999) showed that the bone preservation in general was satisfactory. This may be due to a selective recovery of the bones; actually we did not track any indication for sieving during the excavation. The percentage of non-identified bones in means of Number of Fragments (NF) was approximately 17% and in means of weight was 1.5%, indicating that the unidentified bones are mostly composed of very small fragments. As a result, the majority of the bones were well preserved enough to be identified.

For the bones that could not be identified precisely, two artificial groups were introduced, large mammals (LM) and small ruminants (SR). The large mammal category (LM) comprises bones of bovines and equids, which comprise about 20% of the total remains. The small ruminant category (SR) comprises the non-distinguished bones belonging to caprines and gazelle (27%). In order to have a better view of the ratio of each family group in the faunal spectra, we decided to distribute the remains of LM category between bovines and equids and those of SR category between caprines (*Ovis* & *Capra*) and gazelle proportionally. The identified bones in the faunal assemblage of Haftavan Tepe belong mostly to the wild and domestic large and medium size mammals.

General characteristics of Haftavan Tepe faunal assemblage

Based on NISP, bovines are the most common identified taxa. Bovines are followed in abundance by caprines with sheep outnumbering goats (2:1). Caprines are followed by equids, gazelle, suids, canids and cervids. Birds, amphibians, reptiles and fish are rare or absent in the assemblage. Relative frequencies are also calculated based on the bone weight. This method is used in order to estimate the importance of taxa in contribution of meat exploitation. The bone weights indicate that cattle make up more than two thirds of the weight of the assemblage, while caprines make up about 21%.

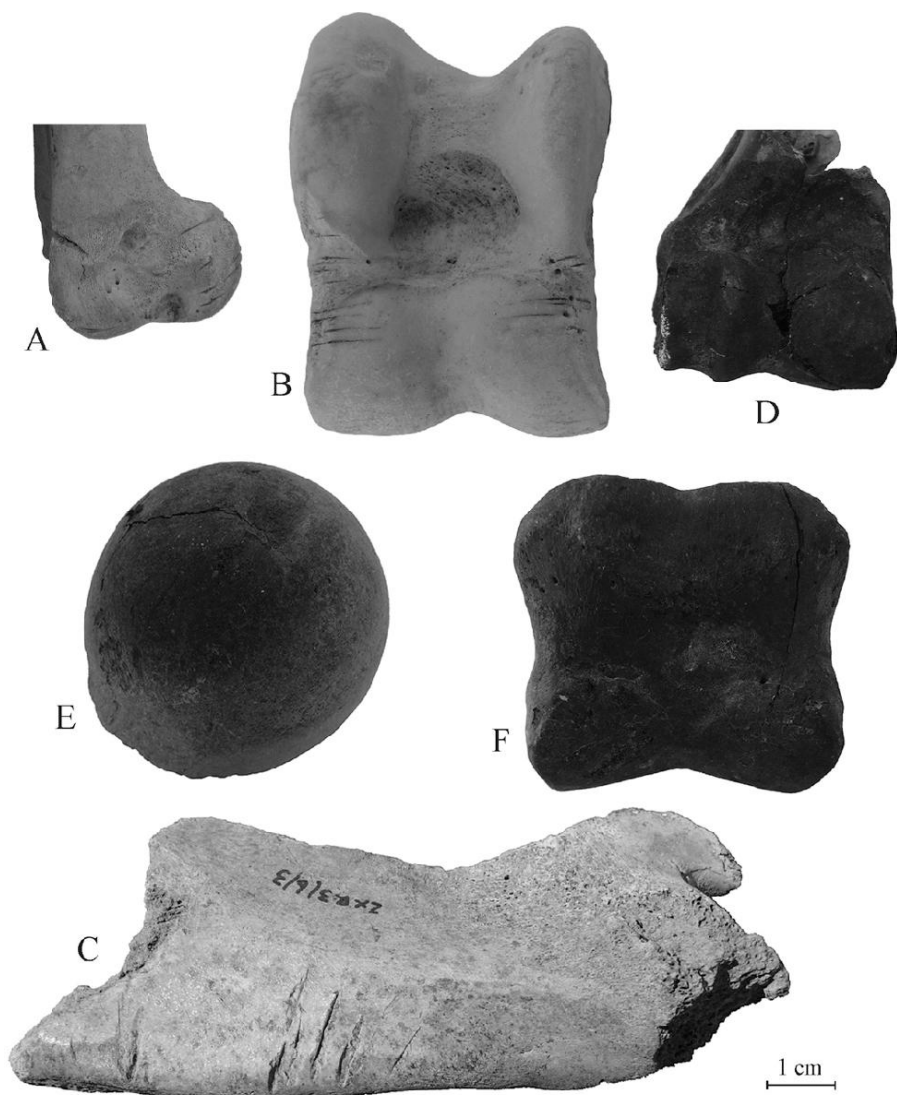


Fig. 11.2. Traces of human activity. Butchery marks A: Left humerus (medial view) of Ovis, B: Left talus (dorsal view) of Bos and C: Left mandible of equid from the Middle/Late Bronze Age levels. Cooking traces or burning D: Right humerus (cranial view) of caprini from the historical levels, E: Femur head (proximal view) of Bos from the Middle/Late Bronze Age levels and F: 2nd phalanx (dorsal view) of equid from the Iron Age levels.

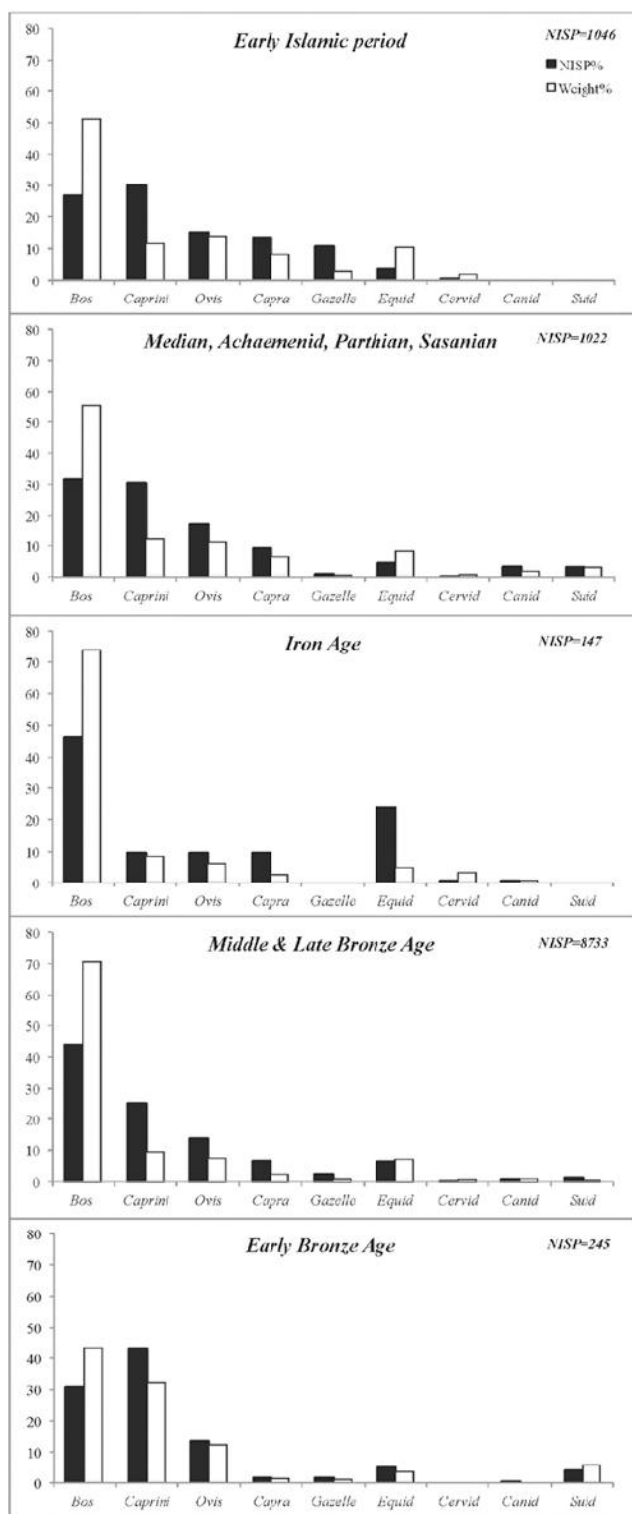


Fig. 11.3. Distribution of the number of identified bones and bone weight in

The distribution of different taxa in terms of number of identified specimens (NISP) and bone weight in different periods of Haftavan Tepe is presented in [Figure 11.3](#). Animal bones were identified to the level of species whenever possible which will be discussed in details below.

Domestic and wild species

Bovines

At the present time bovines found in Iran are *Bos taurus*, Eurasian species and *Bos indicus*, Asian/African species. In northern Iran, on the eastern margins of the Caspian Sea, there is also the domestic water buffalo, *Bubalus bubalis* (Uerpmann 1987).

The major group of the mammal bones at Haftavan Tepe refers to bovines which represents 41% of the specimens identifiable to genus, based on NISP and 68% based on bone weight. The highest representation of bovines belongs to the IA (46%) and the MLBA (44%). The number of bovines in the EBA and the MAPS is nearly the same (31% and 32% respectively), and in the EI is the lowest (27%).

The evolution of the NISP of identified species and their weights in five periods of Haftavan Tepe is shown in [Figure 11.3](#). The relation between the NISP and bone weight of ungulates, shows the importance of the species as a meat resource. The bone weight of bovines in Haftavan Tepe highlights even more the economic importance during all the settlement periods.

DIACHRONIC SIZE EVOLUTION OF BOVINES IN DIFFERENT PERIODS OF HAFTAVAN TEPE

In order to characterise the size of bovines at Haftavan Tepe, we analysed the metric data of this species in each archaeological period separately. For this analysis, we used the method of *Log Size Index (LSI)* (Uerpmann & Uerpmann 1994; Meadow 1999) and as the reference (zero line) we used the average of metric data from two modern domestic cattle, male and female from France (Helmer 1992) ([Fig. 11.4](#)).

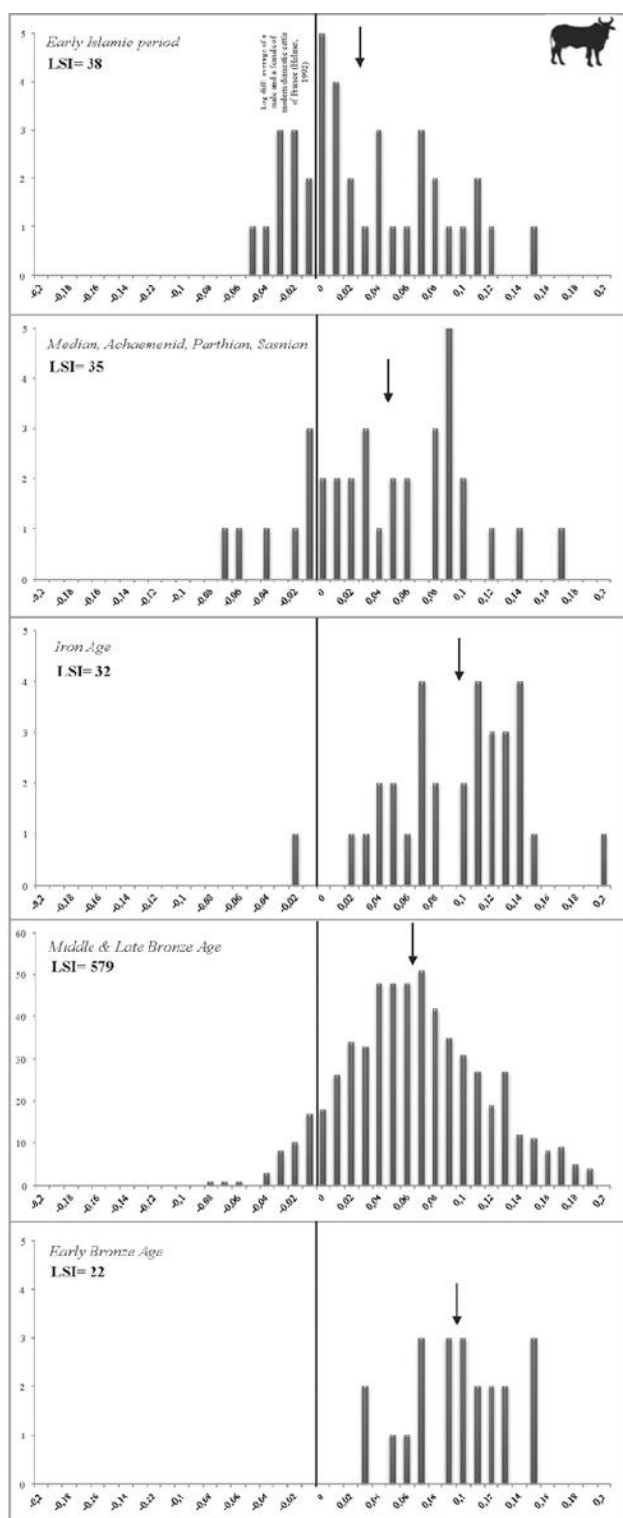


Fig. 11.4. Log Size Index (LSI) representation of bovines at Haftavan Tepe.

The measurements used for this analysis are Bd and Ht of humerus; Bp and Bd of radius; Bp and Bd of metacarpus; Bp and Bd of metatarsus; Bp of the 1st, 2nd and 3rd phalanges; Bd of tibia; GLL of talus and GL of calcaneus.

On the basis of a thorough metrical analyses (Mohaseb 2012), the bovines of Haftavan Tepe were allocated to the domestic cattle, *Bos taurus*. Here we would like to examine the evolution of size of the domestic stock during the various periods. These histograms show that the averages of LSIs of the bovine population in all periods of Haftavan Tepe are generally higher than the reference.

The bovines of the EBA, the oldest period, are larger than all of other periods (mean=0.092). Based on the t tests, from the EBA (mean=0.092) through the MLBA (mean=0.061), the size of bovines decreases significantly ($p=0.0008$). In the following period a significant increase ($p=0.0023$) in size of bovines is observed from the MLBA (mean=0.061) to the IA (mean=0.089). The LSI of the MAPS is of 0.041 and that of the EI is of 0.024.

From the MAPS to EI and from the EBA to IA, the difference between the averages of the logarithmic size is not significant ($p=0.1747$ and 0.8052 respectively). For all of the others, the chronological size decrease is significant (for IA/EI and EBA/EI $p<0.0001$; for MLBA/ EI and EBA/MAPS $p=0.0001$; for IA/MAPS $p=0.0003$ and for MLBA/MAPS $p=0.0468$). The significant difference between the bovine populations exposed above seems to be related to the exploitation of more or less smaller animals (young males and females). For example this is clearly visible between MLBA and IA. This raises the problem of a different type of exploitation of the animals between these periods. Actually, this hypothesis was verified on the kill off patterns of bovines, where animals of less than one year are not represented at all. According to the kill off pattern analyses it seems thus that the shift of the average size of bovines in the LSI diagrams is mostly due to the absence of young animals rather than females.

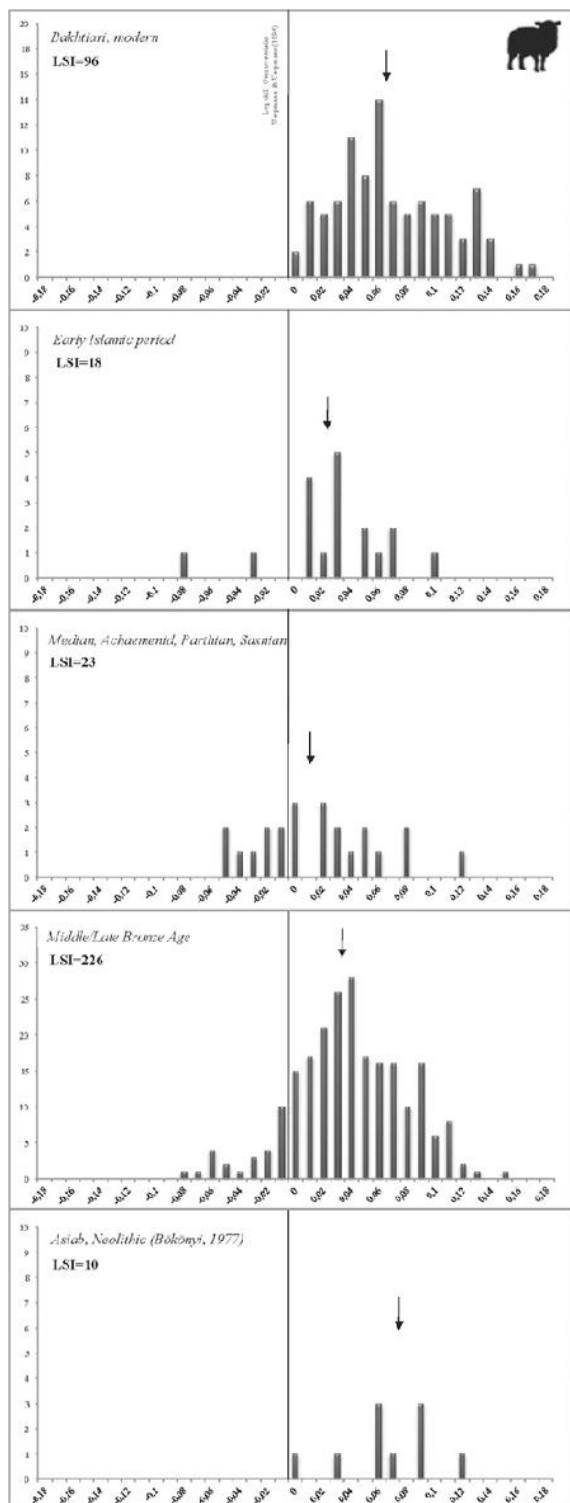


Fig. 11.5. Histogram of the Log Size Index (LSI) for comparison between

the size of sheep at Haftavan Tepe and the reference. The measurements used for this analysis are SLC, GLP, LG and BG of scapula; Bd and Ht of humerus; Bp, SD and Bd of radius; Bp, Dp, SD, Bd and Dd of metacarpus and metatarsus; Bp, SD, Bd and Dd of tibia; GL, Bp, SD and Bd of the 1st phalanx; GLL, GLm, Di and Bd of talus and GL of calcaneus.

Caprini

The other major groups of ungulates are caprines (48%) from which 14% belongs to sheep and 7% belongs to goat and most of them belong to domesticate (Boessneck 1969, Clutton-Brock *et al.* 1990). Also 26% of the remains could not be identified as either sheep or goat and constitutes the category caprines. A little number of wild sheep, *Ovis orientalis* and wild goat, *Capra aegagrus* horn cores could also be identified. The bone weights of caprines (about 21%) in Haftavan Tepe also show the economic importance of this group but it is very much different to the importance of bovine bones in the settlement periods.

In four periods, EI, MAPS, MLBA and EBA, sheep outnumber goat and only in the IA there tends to be equal ratios for these animals. The ratio of goat to sheep in four periods are 1:1.1 in the EI, 1:1.9 in the MAPS, 1:2.1 in the MLBA and 1:8.3 in the EBA. The difference between these two species is the highest in the EBA.

DIACHRONIC SIZE EVOLUTION OF CAPRINES IN DIFFERENT PERIODS OF HAFTAVAN TEPE

In order to characterize the size of caprines at Haftavan Tepe, we analysed the metric data (Driesch 1976) of these species in each archaeological period by using the method of *Log Size Index (LSI)*.

Ovis: In the logarithmic analysis of sheep, we used the measurements of a female wild individual, *Ovis orientalis*, from Iran (Uerpmann & Uerpmann 1994) as the reference or zero line (Fig. 11.5). For having a better idea of the possible range size of a wild population, we chose to compare them with the Asiatic wild sheep (Bökönyi 1977, reused by Mashkour 2001; 2002).

The LSI for *Ovis* is between 0.00 and 0.115. In parallel, we know that domestic breeds can have a very large size variation. In this figure, we also represent an Iranian population of domestic sheep, *Ovis aries*, which comprises 10 females and 2 males. This population originates from the herds of Bakhtiari nomads in southwestern Iran collected and prepared by Mashkour in 2001 (Mashkour 2003; Mashkour *et al.* 2005) and measured soon after (Mohaseb & Mashkour unpublished data). The Bakhtiari population, although rustic, is very large in size. The LSIs are between -0.08 and 0.196. This population

has even larger animals than Asiab.

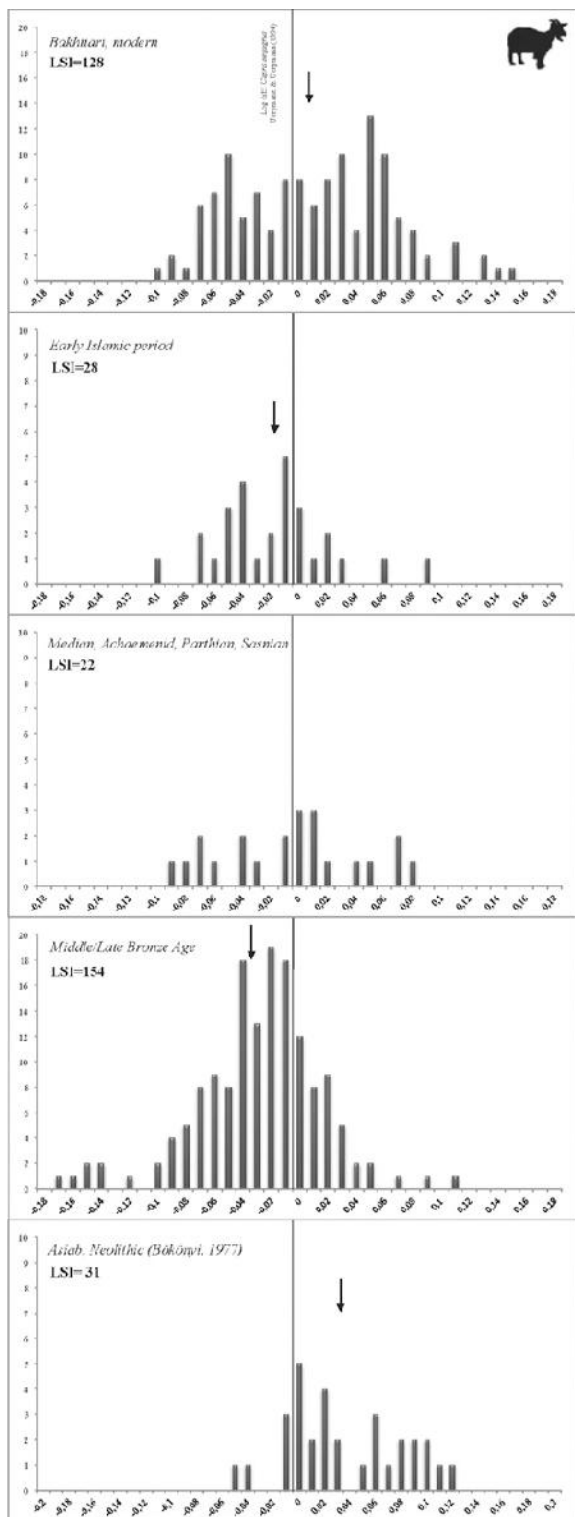


Fig. 11.6. Histogram of Log Size Index (LSI) for comparison between the

size of goat at Haftavan Tepe and the reference. The measurements used for this analysis are SLC, GLP, LG and BG of scapula; Bd and Ht of humerus; Bp, SD and Bd of radius; Bp, Dp, SD, Bd and Dd of metacarpus and metatarsus; Bp, SD, Bd and Dd of tibia; GL, Bp, SD and Bd of the 1st phalanx; GLL, GLm, DL and Bd of talus and GL of calcaneus.

The LSI diagrams for sheep are presented in MLBA, MAPS and EI. For other periods, the metric data were under-represented. Between the three periods of Haftavan Tepe, the MLBA has the widest range of variation of LSIs. In MAPS, the frequency of smaller animals (< 0.00) is more than MLBA. It should be stressed that the largest individual (LSI=0.15) and the largest average (0.034) represent in the MLBA. In MAPS, the size of sheep decreases by an average of 0.012. According to *t* test, the increase of size from the MLBA to the MAPS is significant ($p=0.030$). For all the others, the chronological size difference is not significant (for MLBA/EI $p=0.265$ and for MAPS/EI $p=0.422$).

The question behind these metric analyses is to determine the contribution of the wild specimens. The distribution of LSIs in the Haftavan populations of MAPS and EI show a clear break between 0.07 and 0.08. This break is not visible in the MLBA, obviously because of important number of data, which might hide this effect. According to the reference used above (Asiab and Bakhtiari) and to the distribution of LSIs discussed, we consider that all LSI values above 0.08 belong to the wild. The wild sheep, *Ovis orientalis* is more firmly documented by the presence of horn cores in Haftavan Tepe during the MLBA and MAPS (Mohaseb 2012).

Capra: In the logarithmic analysis of goat, we used the average of measurements of two wild individuals, *Capra aegagrus*, one male and one female, from Turkey (Uerpmann & Uerpmann, 1994) as the reference (zero line) (Fig. 11.6). For goat also, we used the measurement of wild population of Asiab to distinguish the wild individuals at Haftavan Tepe and domestic goats of Bakhtiari population, which comprises 8 females, 5 males and 2 castrates.

As for sheep, we could only analyse the metric data from three periods of EI, MAPS and MLBA. Between these three periods, the MLBA has the widest range of variation of LSIs. Also the largest individual is present in this period (LSI=0.11).

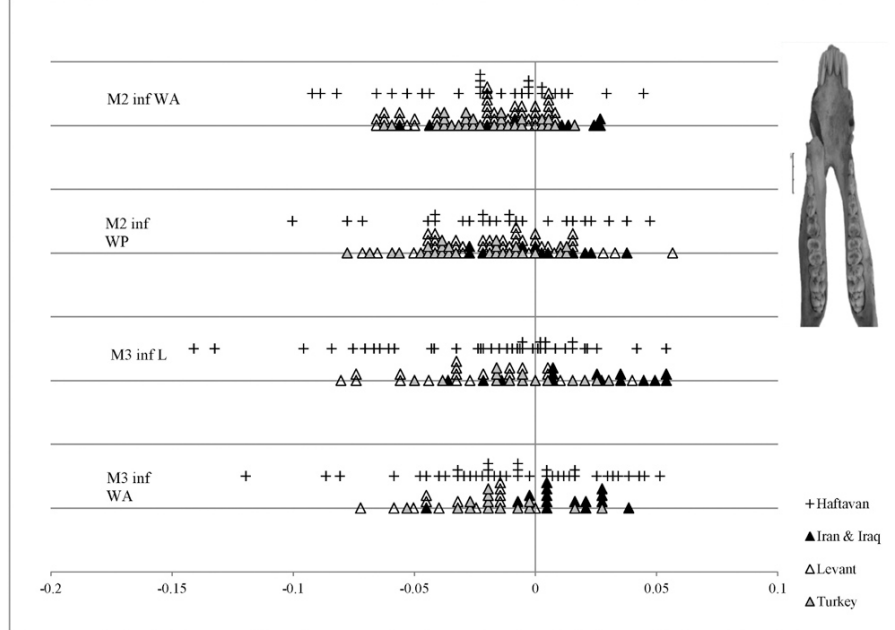


Fig. 11.7. Size of the 2nd and 3rd molars in Suids from Haftavan Tepe in comparison with wild boars from Iran, Iraq, Turkey and Levant (Payne & Bull 1988; Albarella et al. 2009) as reference collection. Standard measurement (zero line) is from Kizilcahamam, Turkey (Payne & Bull 1988). Right: Suid mandible recovered from Bronze Age levels in Haftavan Tepe.

The comparisons between periods (according to *t* test) show that from the MLBA (mean = -0.036) to the MAPS (mean = -0.011), the size of goat increases significantly ($p=0.0387$). The mean value of goats is the largest in the MAPS. From this period to the EI (mean = -0.023) the size of goat decreases but this difference is not significant ($p=0.382$). The population of domestic goat of Bakhtiari is very large like the population of sheep and the LSI of the largest animal is of 0.15, which is larger than that of the MLBA. According to the wild and domestic situation of goats of Haftavan Tepe, we noticed one pair of horn cores from the MLBA, which belongs certainly to a wild individual, *Capra aegagrus*.

According to the average LSI for Asiab and the LSI distribution in Haftavan assemblages, we consider that all values above 0.04 belong to the wild. It should be noted that there is also the probability of presence of castrates between the larger ones (as goats of Bakhtairi in which the castrates are the largest) but we have not enough data to confirm it.

Suids

The presence of suids (*Sus scrofa scrofa*) has been observed in small quantities mainly in the Early Bronze Age (4%) and the MAPS (3%). The remains of wild boar are absent in the Iron Age and the Early Islamic period. Noteworthy is the large amount of complete suid mandibles (n=80) recovered from the MLBA levels (trenches X2 levels 2B, 3B and X3 level 2) corresponding to about 60 animals. This is a very uncommon pattern and no explanations could be found in the published reports by Burney.

We examined the metrical data from the second and third lower molars in comparison with wild boars from Iran, Iraq, Turkey and Levant (Payne & Bull 1988; Albarella *et al.* 2009). Most of wild boars from Levant are provided by Simon Davis and they include the smallest animals of the region. The Turkish animals are from Kizilcahamam, which were measured by Payne and Bull (1988) and also are used as the standard measurement. These two groups belong to the subspecies *Sus scrofa lybicus* (Groves 1981). The wild boars from Iran and Iraq are the largest group of this region and they belong to the subspecies *Sus scrofa attila* (Groves 1981) (Albarella *et al.* 2009).

In order to compare the reference data of wild boars with the specimens of Haftavan Tepe, we used the ratio diagram method (Fig. 11.7).

In this graph the four measurements from two lower molars, crown length (L) and anterior crown width (WA) of third molar (M3), anterior crown width (WA) and posterior crown width (WP) of second molar (M2) are situated inside the zone of wild boars and even some of them are larger (WA in M2 and M3). Only two or three individuals are smaller than wild boars of the reference collection, which could be allocated to domestic forms. These teeth belong to the MLBA and there is not enough metrical data from other periods to have a more precise distinction of wild and domestic forms of this species in Haftavan Tepe.

The question of the distinction of domestic and wild boars through morphometric geometric analysis and genetics (Evin *et al.* 2013; Ottoni *et al.* 2013) is a topic that has been investigated for some times and published recently. The results of the wild and domestic status of the suids of Haftavan Tepe based on the morphometric geometric analysis (Evin *et al.* 2014) are not always the same as which is distinguished based on metrical analysis. Although the *Sus* population of Haftavan is extremely homogenous by its context and anatomy, there remains a doubt on the identification of the younger specimens

of our assemblage that will be under further investigations.

Equids

The remains of equids are mostly represented in the MLBA. For the analysis of metric data and therefore the specific identification of different species of equids, we used the 'ratio diagram' method (Simpson 1941; Eisenmann 1979; 1986) of first phalanx, the most abundant equid remains in the site (Fig. 11.8).

In these diagrams the standard data (zero line) is the mean of 30 anterior first phalanges of *Equus hemionus onager* (Eisenmann & Mashkour 2000). The archaeological material is compared with the first phalanges of five equid species; horse, *E. caballus* (average of 24 posterior and 31–38 anterior); mule, *E. caballus* ♂ x *E. asinus* ♀ (average of 9 posterior and 5–9 anterior); hemione, *E. h. onager* (average of 29–30 posterior) and donkey, *E. asinus* (average of 10–11 anterior) (Eisenmann official site: www.vera.eisenmann.com; Eisenmann & Mashkour 2000; Dive & Eisenmann, 1991). We complemented these ratio diagrams with a principal component analysis for a finer identification of Haftavan Tepe equids (Fig. 11.9).

On the basis of the two first logarithmic profiles (Fig 11.8A & B), horse and mule are very similar and more or less of the same size, therefore it is not easy to distinguish the specimens located in this area. The distinction between these two species is more precise according to the PCA (Fig. 11.9).

In Figure 11.9, the specimens #260, #328, #334, #380 (MLBA) and #397 (MAPS) are posteriors and are situated in the distribution area of horse. The specimens #333 (MLBA), #390 (EBA) and #393 (MAPS) are situated in the distribution area of mule; the two former are posterior and the latter is anterior. There are also four specimens situated in the overlap zone between horse and mule and could be allocated to either of them: #326, #330, #335 (MLBA) and #430 (IA). Except for the #335, which is a posterior, the others are anterior phalanges.

On the third logarithmic profile (Fig. 11.8C) there are three specimens, which could be allocated to onager. These specimens are situated in the overlap zone between onager and donkey but they are exactly in the distribution area of concentration of onager and furthermore their profile resembles to that of onager. They are #261, #262 and #332, all posteriors and belong to the MLBA. Another possibility is that these specimens are hybrids of hemione and donkey, even if for the moment we do not have any possibility to verify this assumption. It should be reminded that during the Bronze Age in Iraq

and Syria, the hybridisation of hemione and donkey was practiced (Zarins 1986). Finally [figure 11.8D](#) presents the specimens allocated to donkey. In the PCA, these specimens are also projected in the distribution area of donkey. These are specimens #263, #327, #329 and #331, all the anterior phalanges and belong to the MLBA.

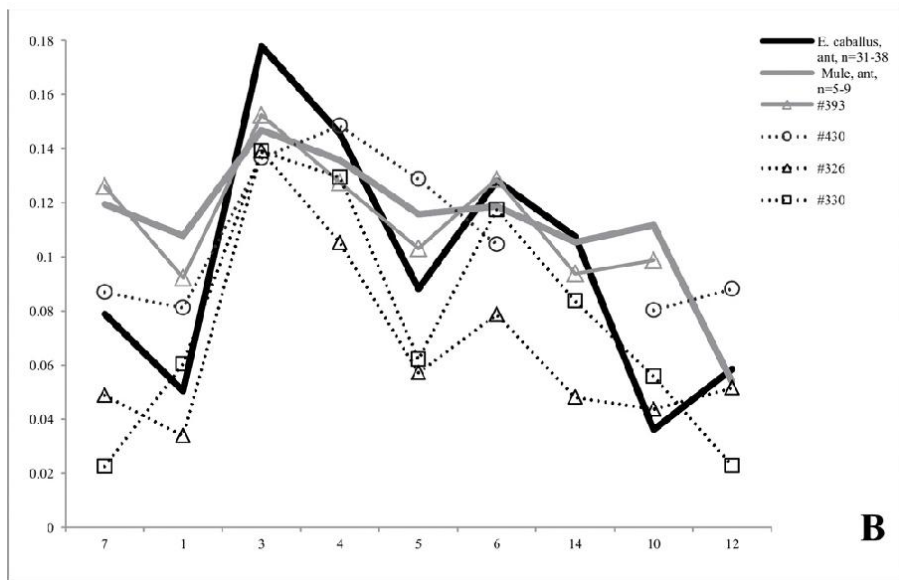
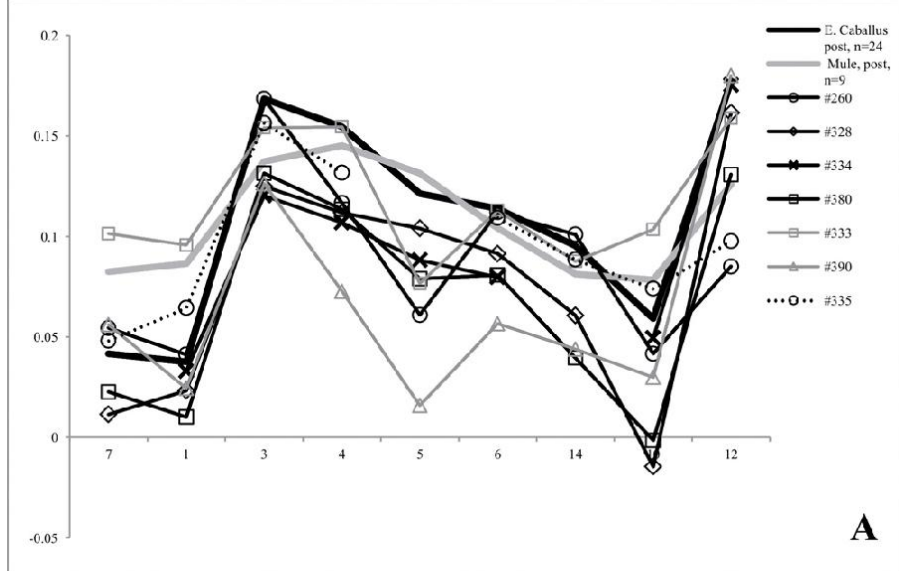
Considering these identifications, it could be deduced that horse is well represented in the MLBA and the MAPS and the hybrids (mule) are present in the EBA, the MLBA and the MAPS. In the MLBA levels either hemione or a hybrid (hemione x donkey) could be observed. Donkey was clearly exploited during the MLBA. In the MLBA and the IA levels we observe the presence of cut marks and burning on a mandible and a second phalanx of equid respectively (see [Fig. 11.2](#)). It is not clear if this is related to squaring or to consumption.

Gazelles

Among the small herbivores, very little remains of gazelle, mostly horn cores (about 3%) could be allocated to *Gazella subgutturosa* ([Fig. 11.10A](#)). The exploitation of gazelle during the EBA was about 1.6%, about 2.3% in the MLBA, none in IA and about 0.8% in the MAPS, but in the EI hunting of this species suddenly increases (10.8%). The distribution of gazelle in Azerbaijan nowadays is limited to the Eastern parts of the region (Ziaei 1996).

Cervids

Remains of cervids were also identified in very small quantities and mostly antlers. The highest number of cervids is observed in the IA (0.7%) and the EI (0.6%). The cervids are less than 0.2% in the MLBA, 0.1% in the MAPS and absent in the EBA. Two species are present in Iran, the red deer, *Cervus elaphus* and the Mesopotamian fallow deer, *Dama mesopotamica*, the distinction of which is generally difficult on many bones. On the basis of the morphological criteria described for the antlers the Haftavan remains were securely allocated to red deer ([Fig. 11.10B](#)). Nowadays, the main habitat for red deer in Iran is the south margins of Caspian Sea and its distribution is rather limited in Azerbaijan (Ziaei 1996).



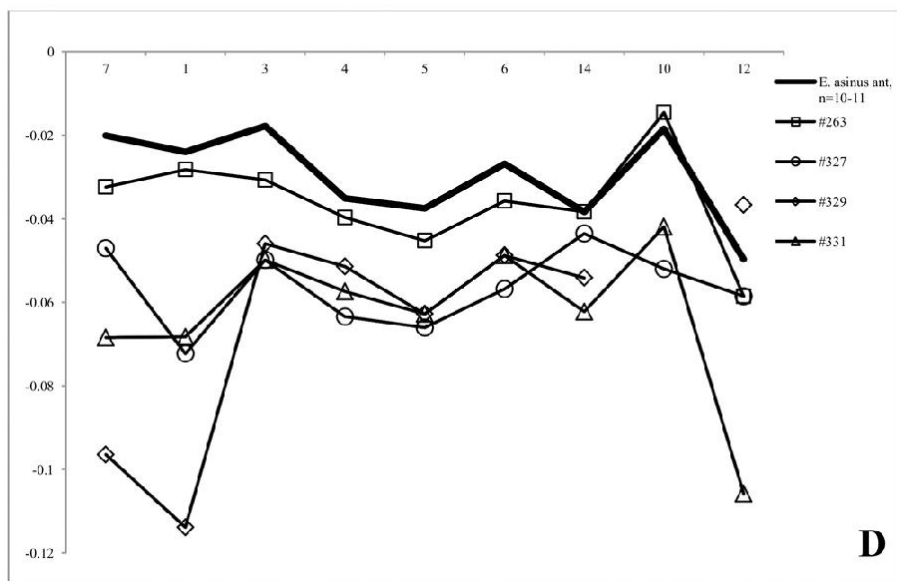
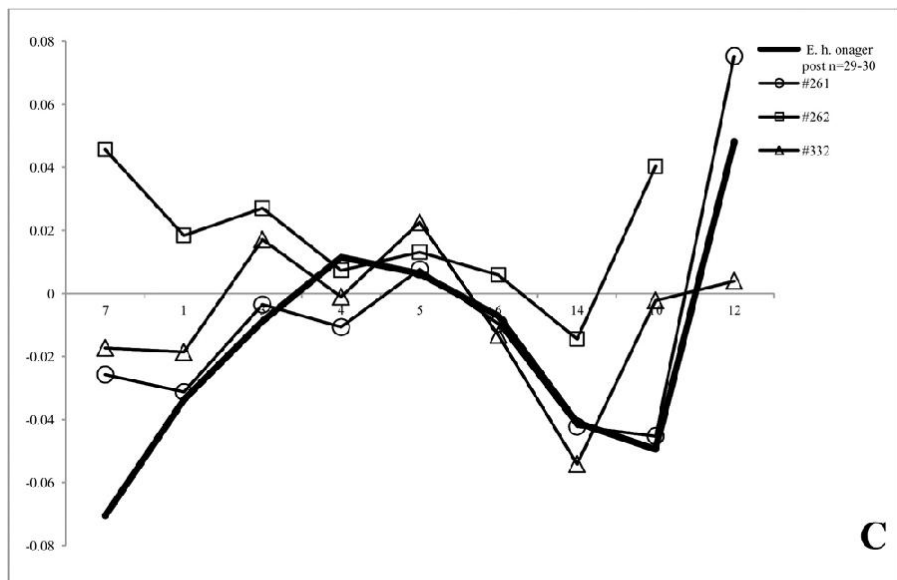


Fig. 11.8. Diagram of Log Size Index to distinguish the different species of equids in Haftavan Tepe in comparison with the reference measurements. A and B: Anterior and posterior phalanx of horse and mule. C: Posterior phalanx of hemione. D: Anterior phalanx of donkey. The codes (e.g. #260) represent the specimens of Haftavan Tepe.

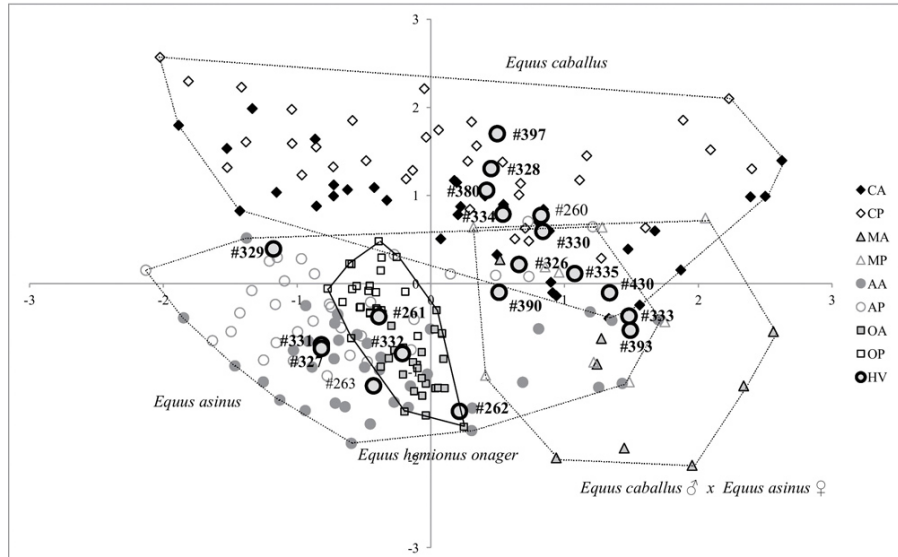


Fig. 11.9. Principal Component Analysis (PCA) of equid first phalanges of Haftavan Tepe in comparison with the reference data: CA and CP = horse, anterior and posterior phalanges; MA and MP = mule, anterior and posterior phalanges; AA = donkey, anterior and posterior phalanges; OA = onager, anterior and posterior phalanges.

Carnivores

In all periods of Haftavan Tepe, except for the EI, the remains of domestic dog (*Canis familiaris*) are present in small quantities. These remains comprise less than 1% of the total, but in the MAPS it comes to more than 3%. There is no observation of other carnivores in this site. Traces of carnivore gnawing (1–2%) and digestion (<0.1%) are observed on some bones of large mammals and small ruminants.

Evolution of animal exploitation

Haftavan Tepe is remarkable for the high ratios of bovine bones (Fig. 11.3). This is an uncommon trend on the Iranian Plateau where the most exploited domesticates are caprines (Mashkour 2001; 2002).

Bovines comprise 41% of the total remains and their weight constitutes about 68%, whereas caprines are represented by 48% and their weight constitutes only about 21%. This might be related to the geographical location and environmental setting of the site. Azerbaijan has a favorable climate, which is more suitable for cattle herding.

The practice of hunting in this site was a minor activity (about 2.5%). The hunted species in Haftavan Tepe are *Gazella subgutturosa*,

Cervus elaphus, *Sus scrofa* and *Equus hemionus*. No wild carnivores could be identified in the assemblage. These species belong to various ecological settings, going from steppe (gazelle and hemione) to more bushy (*Sus* and *Cervus*) environments. The distribution of mammals in different periods of Haftavan Tepe, identified to the level of genus, is represented in [Table 11.3](#).

As mentioned above, the faunal remains in Haftavan Tepe mostly belong to mammals especially small and large herbivores and are predominately domestic. In this site it was difficult to understand the exploitation of other class of animals, such as fish or birds, as food source, probably due to hand collection and size selection of bones during excavation. Only a few number of bird bones and no fish were found in remains.

Herding in Haftavan Tepe

Despite the relative frequency of different domesticates, the information about the age at which the animals are slaughtered, gives valuable indications about animal management. This depends on different factors: the characteristics of herded animals, environmental conditions and finally the needs of different products in society (Payne 1973). The methods, by which we determined the age of animals at death, provide information about the exploitation of different products (meat, milk and dairy products, wool and skin). These methods address the most economically important species: cattle and sheep/goat.



Fig. 11.10. A: *Gazella subgutturosa* horn core recovered from Bronze Age levels; B: *Cervus elaphus* antler recovered from Iron Age levels of Haftavan Tepe.

Cattle

The kill-off pattern for cattle is considered in lower cheek teeth, by the sequence of tooth wear stages, based on the study of Ducos (1968) using indices of crown height to transversal diameter of the tooth, Grant (1982) using the morphology of tooth wear, and the date of eruption given by Silver (1969), Higham (1967) and Grigson (1982a, b). Here, we used the profile of cattle in three periods: the MAPS, the IA and the MLBA. The number of teeth in the EI and the EBA was not enough to analyse kill-off pattern.

The understanding of kill-off patterns in cattle is based on the physiology of animal (Balasse *et al.* 2000). Cows need a stimulus to gain the milk which can be the manipulation of udder or various stimuli such as visual, hearing, olfactory and smelling (Metge 1990). The high representation of young animals (from birth to 2 years old) shows the exploitation of milk (Tresset 1996; Balasse *et al.* 2000). The presence of these young animals is generally associated with the presence of old females (6.5–9 years old). The exploitation of meat is represented by the slaughtered animals between 2–4 and 4–6.5 years

old in which the latter is obviously less tender. The presence of very old animals is the evidence for using cattle for its strength (more than 9 years old).

On the basis of this source of information, the herding strategies in the periods MLBA and IA, which is based on the reconstruction of the kill-off pattern of 20 and 10 individuals respectively, are more or less the same (Fig. 11.11). The peak at the age of 2–4 years (44% for the MLBA and 41% for the IA, most probably the males) demonstrates the exploitation of high quality meat. In the IA, there is a second peak at the age of 6.5–9 years, which is associated with the animals less than 2 years and demonstrates the exploitation of milk and dairy products. This trend is less important in the MLBA. The use of cattle as draught animal, as confirms the presence of pathological bones (especially lipping), is demonstrated by the animals slaughtered older than 9 years old. This type of exploitation has more or less the same importance in both periods.

Table 11.3. Haftavan Tepe: Relative frequency of taxa identified to genus, calculated using NISP in different periods.

Species	Early Islamic Period		MAPS Periods		Iron Age	
	NISP	NISP%	NISP	NISP%	NISP	NISP%
<i>Bos taurus</i>	278	26.58	323	31.60	68	46.26
<i>Caprini</i>	314	30.02	310	30.33	14	9.52
<i>Ovis aries</i>	156	14.91	173	16.93	14	9.52
<i>Ovis orientalis</i>	1	0.10	3	0.29	0	0.00
<i>Capra hircus</i>	138	13.19	89	8.71	14	9.52
<i>Capra aegagrus</i>	2	0.19	5	0.49	0	0.00
<i>Gazella subgutturosa</i>	113	10.80	8	0.78	0	0.00
<i>Equus caballus</i>	0	0.00	1	0.10	0	0.00
<i>E. caballus</i> ♂ x <i>E. asinus</i> ♀	0	0.00	1	0.10	0	0.00
<i>Equus hemionus onager</i>	0	0.00	0	0.00	0	0.00
<i>Equus asinus</i>	0	0.00	0	0.00	0	0.00
<i>Equid</i>	38	3.63	44	4.31	35	23.81
<i>Cervus elaphus</i>	6	0.57	1	0.10	1	0.68
<i>Canis familiaris</i>	0	0.00	33	3.23	1	0.68
<i>Sus scrofa</i>	0	0.00	31	3.03	0	0.00
Total	1046	100	1022	100	147	100.00

Species	Middle & Late Bronze Age		Early Bronze Age		All Periods	
	NISP	NISP%	NISP	NISP%	NISP	NISP%
<i>Bos taurus</i>	3827	43.82	75	30.61	4571	40.84
<i>Caprini</i>	2203	25.23	106	43.27	2947	26.33
<i>Ovis aries</i>	1150	13.17	33	13.47	1526	13.63
<i>Ovis orientalis</i>	44	0.50	0	0.00	48	0.43
<i>Capra hircus</i>	562	6.44	4	1.63	807	7.21
<i>Capra aegagrus</i>	10	0.11	0	0.00	17	0.15
<i>Gazella subgutturosa</i>	202	2.31	4	1.63	327	2.92
<i>Equus caballus</i>	4	0.05	0	0.00	5	0.04
<i>E. caballus</i> ♂ x <i>E. asinus</i> ♀	1	0.01	1	0.41	3	0.03
<i>Equus hemionus onager</i>	3	0.03	0	0.00	3	0.03
<i>Equus asinus</i>	4	0.05	0	0.00	4	0.04
<i>Equid</i>	534	6.11	11	4.49	662	5.91
<i>Cervus elaphus</i>	21	0.24	0	0.00	29	0.26
<i>Canis familiaris</i>	63	0.72	1	0.41	98	0.88
<i>Sus scrofa</i>	105	1.20	10	4.08	146	1.30
Total	8733	100	245	100	11193	100.00

During the MAPS represented by 11 individuals, the herders exploited animals in a different way. In these periods the exploitation of milk and dairy products is much more important than butchery exploitation, which is demonstrated by the abundance of animals

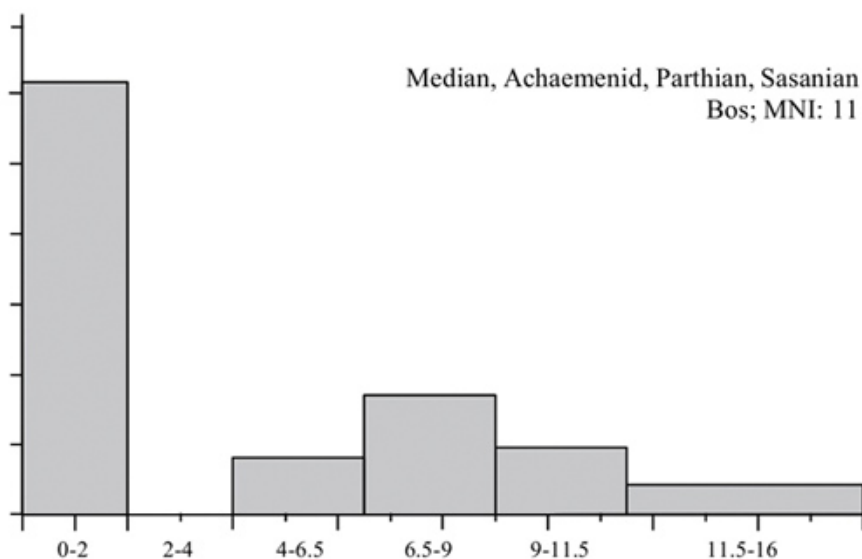
slaughtered in less than 2 (62%) and 6.5–9 years (17%) and the absence of animals at the age of 2–4 years. The representation of very old animals is less than the two previous periods (13%) but it shows however the use of animal as draught.

The use of cattle as a draught animal is an extremely interesting aspect, which points directly to the development of agricultural practices such as ploughing. This question should be addressed through systematic and integrated archaeological, archaeobotanical and archaeozoological investigations for documenting more precisely the relation between the exploitation of cattle and the development of cereal farming. Unfortunately, no archaeobotanical studies have ever been performed for Haftavan Tepe. In absence of such source of information, archaeozoology can contribute to some extent to this question since it is generally admitted that cattle is an animal that has been used for its strength. In this regard one can note the progressive and general increase of bovines from the Bronze Age in the faunal spectra of the Iranian Plateau (Mashkour 2001). In Haftavan Tepe, the period with the highest occurrence of old animals is MLBA through IA.

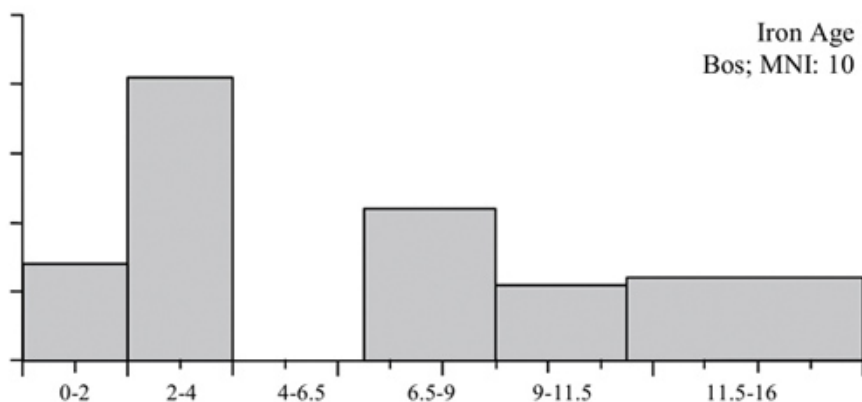
Caprini

Age profiles for caprines were performed using inferior tooth wear and eruption based on references established by Payne (1973) and Helmer (1995).¹ The distinction of sheep and goat on teeth relies on studies by Payne (1985), Helmer (2000) and Halstead *et al.* (2002) for all teeth and Uerpmann & Uerpmann (1994) and Balasse *et al.* (2005) for the 3rd molar. For the interpretation of the kill-off pattern for sheep and goat we rely on three major methodological studies performed by S. Payne (1973) and J.-D. Vigne and D. Helmer (Vigne and Helmer 1998; Helmer & Vigne 2004).

70%



50%



50%

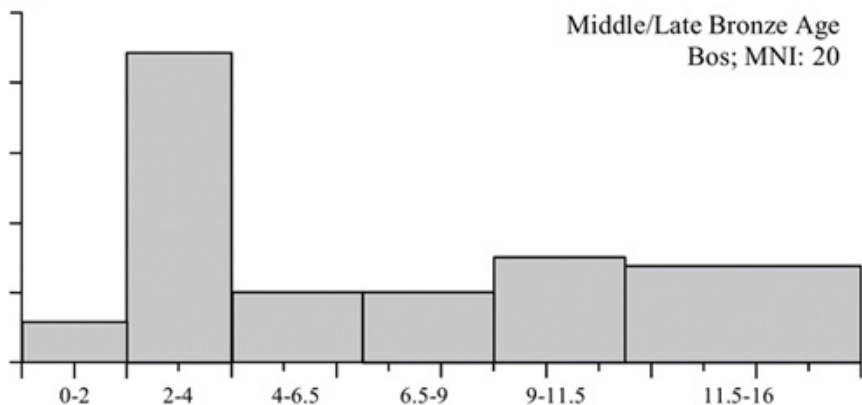


Fig. 11.11. Cattle kill-off pattern in three periods of Haftavan Tepe.

Relying on ethnographic data, these authors have provided an economic interpretation of the kill-off patterns based on the production of three categories of products: meat, milk and wool/hair.

For this study, the number of sheep tooth remains was abundant enough to enable the construction of kill-off patterns for all periods whereas this was not the case for goat remains, only possible for MLBA.

Based upon five profiles built with the remains of more than 150 individuals, we observe a mixed exploitation of sheep for meat, milk and wool ([Fig. 11.12](#)).

During the Early Bronze Age, meat exploitation is expressed by a relatively high proportion (52%) of animals slaughtered between 6 months and 2 years old, equally divided between animals of 6–12 months (class C) and 1–2 years (class D) that produce a more tender meat when younger. The milk and dairy products exploitation is expressed by the relatively high percentage of animals, and most probably females, slaughtered at the age of 4–6 years (class G: 24%) plus a lower percentage of animals in the age of 2–4 years (class EF: 16%). Also this high proportion of slaughter in class G and class HI (more than 6 years: 7%) indicates the exploitation of wool more than other periods in the site.

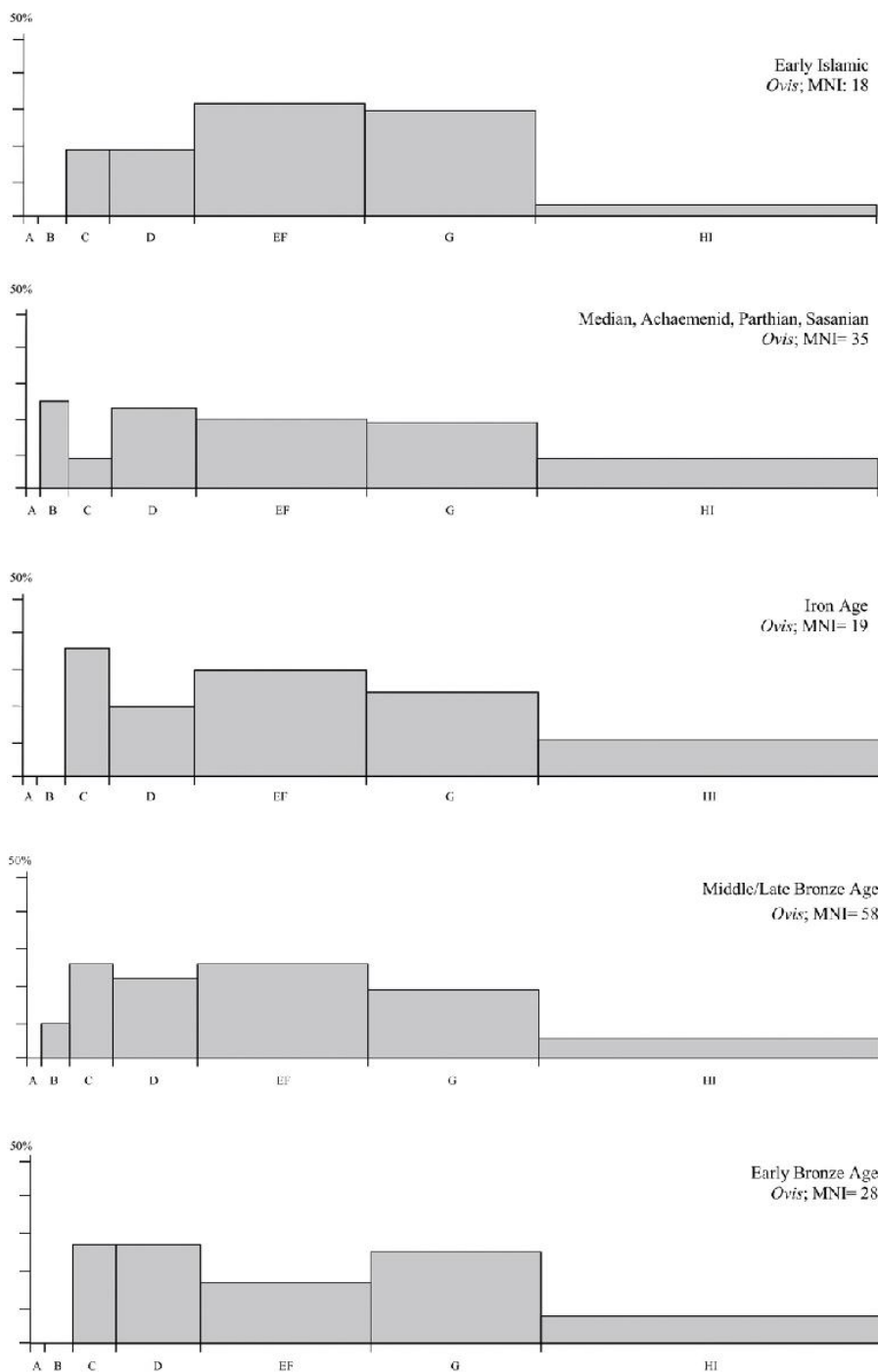


Fig. 11.12. Sheep kill-off pattern in five periods of Haftavan Tepe.

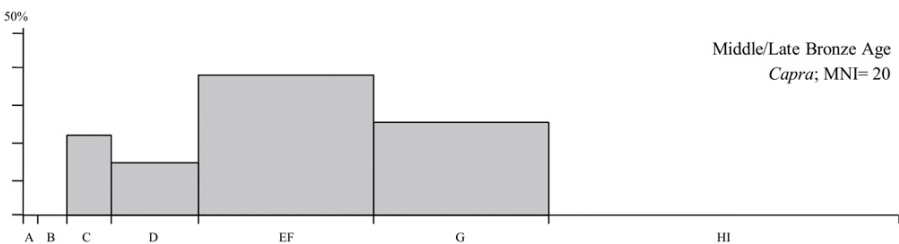


Fig. 11.13. Goat kill-off pattern in the Middle/Late Bronze Age of Haftavan Tepe.

The aim of sheep exploitation during the Middle/Late Bronze Age (MLBA) is based on the reconstruction of the kill-off pattern of 58 individuals, which is statistically very reliable. During this period, milk exploitation seems to be enhanced by a higher percentage of slaughter in Classes EF (25%) and G (14%). The milk exploitation is even more important for goat (represented by 20 individual), with the presence of two peaks in classes EF (37%) and G (26%) (Fig. 11.13). For sheep, it seems that there is a preference for the production of more tender meat (class B=10% and C=35.5%) in comparison to the exploitation of less tender meat class D (21%). Globally the same tendency is visible for goat. In the Middle East this is a very widespread practice in rural or nomadic pastoralist contexts referred to as *parvar bandi* (to fatten) within Persian-speaking communities (Ezatzpour 2003). In this system lambs were preserved to reach their maximum weight and that's the reason why they were killed mainly between 6–12 months. This strategy aims principally at meat production, which is generally a response to the dynamic between consumer and producer.

In conclusion, during the MLBA period the sheep and goat are raised more for their milk and dairy products with a slight difference between sheep and goat; sheep being more used for the meat and goat for the milk as is often observed in traditional herding systems. The absence of goats older than 6 years and as it is practically also the case for sheep in this period seems to indicate the little interest to the specialized production of fiber.

The aims of sheep exploitation during the Iron Age (IA) is based on the reconstruction of the kill-off pattern of 19 individuals, shows a similar pattern to that of MLBA.

During the MAPS represented by 35 individuals, milk exploitation seems to be more firmly expressed by a focus on classes EF (19%) and G (18%). In this more sophisticated system, yearlings are separated from ewes as a result of which a higher and more efficient production of milk and meat (class D: 22%). The same pattern seems to continue

during the Early Islamic period. Interestingly in this period, wool exploitation seems to have critically declined (class HI = 3%).

Conclusion in herding strategies

The analysis of faunal spectra and the kill off patterns of Haftavan Tepe show in all periods the reliance of the subsistence economy on cattle, sheep and goat. The favorable environment of the site and the presumably presence of agricultural lands in the vicinity of the site would have in principle allowed a sedentary herding. However, this question is currently under study through stable isotope analyses and may add a higher resolution in this interpretation of our current data.

Characterisation of Haftavan Tepe subsistence economy with adjacent sites in Iran and Turkey

In order to characterise the subsistence economy of Haftavan Tepe during different periods of its occupation within a regional framework, a comparison was made with archaeozoological data from some contemporaneous and adjacent sites in Iran and Turkey. We used the results of 30 faunal assemblages on 18 sites from the Bronze Age, Iron Age and the historical periods including Urartian, Median, Achaemenid, Parthian, Sasanian and Islamic (table in [Fig. 11.14](#)).

The considered zone is limited to the north western part of Central Plateau and Central Zagros in Iran and to the southeastern part of Turkey including the sites of Tigris valley and some sites along the Euphrates ([Fig. 11.14](#)). The Iranian sites are shown on the left side of the graph and the Turkish sites on the right. In each group, the sites are classified chronologically. The predominance of caprines followed by bovines is the first observation to be made for all periods and for all sites and in both regions. There is however an exception for Haftavan Tepe where the contrary is observed during the Bronze Age and the Iron Age. Also it seems that the exploitation of domestic equids is more important on the Iranian sites in comparison to the Turkish sites (5.6% and 1.4% respectively). As for the suids, they are more exploited in Turkey (9.3%) than in Iran (2.5%). This trend could also be seen in the four sites located in the upper Tigris river valley in Turkey, which are Giricano, Kenan Tepe, Müslüman-tepe and Hirbemerdon Tepe all belong to the Bronze Age. The average contribution of domestic suids in these sites is about 20% (Berthon 2011). Finally, game species are more abundant in Iran than in Turkey with an average of 5.6% and 2.6% respectively.

Looking at these raw data through multivariate analysis (Factorial

Correspondence Analysis, FCA) allows a better characterisation of these assemblages and regional trends. In the factorial plans, the variables and the individuals are represented proportionately due to their contribution. The variables used in FCA analysis (Fig. 11.15) are the two groups of domestic and wild animals: bovines (Bos), caprines (Cap), suids (SSd) and equids (Eqd) are the domesticates; the wild group are composed of the wild boar (*Sus scrofa*) and cervids (red deer / *Dama*) (SC) living in humid bushy environments, onager (*Equus hemionus*) and gazelle (EG) living in steppe environments and finally wild caprines (*Ovis orientalis*, *Capra aegagrus*) (OC) living on foot hill and high altitudes.

Site	Country	Region	Location	Period	Author	Year	Code	NR
Takht-i-Suleiman	Iran	North West	Azerbaijan	Late Islamic	Kolb	1972	IT1	2370
Bastam	Iran	North West	Azerbaijan	Islamic	Boessneck & Kokabi	1988	IB1	11670
Haftavan Tepe	Iran	North West	Azerbaijan	Early Islamic	Mohaseb	2012	IH1	330
Takht-i-Suleiman	Iran	North West	Azerbaijan	Parthian/Sassanian	Kolb	1972	IT2	3436
Bastam	Iran	North West	Azerbaijan	Parthian/Sassanian	Boessneck & Kokabi	1988	IB2	423
Haftavan Tepe	Iran	North West	Azerbaijan	Median, Achaemenid, Parthian, Sassanian	Mohaseb	2012	IH2	387
Ziwiye	Iran	Centrale Zagros	Kermanshah	Median	Mohaseb	2012	IZW	323
Tepe Ozbaki	Iran	North of Central Plateau	Savojbolagh Plain	Median	Mashkour & Mohaseb	2011	ITO	149
Doshan Tepe	Iran	North of Central Plateau	Savojbolagh Plain	Median	Mashkour & Mohaseb	2011	ID4	488
Bastam	Iran	North West	Azerbaijan	Uratian	Boessneck & Kokabi/Krauss	1988/1975	IB3	56663
Haftavan Tepe	Iran	North West	Azerbaijan	Iron Age	Mohaseb	2012	IH3	133
Doshan Tepe	Iran	North of Central Plateau	Savojbolagh Plain	Iron Age	Mashkour & Mohaseb	2011	ID3	474
Dinkha Tepe	Iran	North West	Azerbaijan	Iron Age	Gilbert & Steinfield	1977	ID1	253
Sagzabad	Iran	North of Central Plateau	Qazvin Plain	Iron Age	Mashkour/Mashkour et al.	2001/1999	IS1	9601
Bastam	Iran	North West	Azerbaijan	Bronze Age/Iron Age	Krauss	1975	IB4	6586
Sagzabad	Iran	North of Central Plateau	Qazvin Plain	Late Bronze Age	Mashkour/Mashkour et al.	2001/1999	IS2	303
Haftavan Tepe	Iran	North West	Azerbaijan	Bronze Age	Mohaseb	2012	IH4	3877
Kohneh Pasgha Tepesi	Iran	North West	Azerbaijan	Bronze Age	Mohaseb	2012	IKP	299
Dinkha Tepe	Iran	North West	Azerbaijan	Bronze Age	Gilbert & Steinfield	1977	ID2	1321
Godin	Iran	Centrale Zagros	Kangavar, Hamadan	Bronze Age	Gilbert	1979	IGD	15282
Kohneh Tepesi	Iran	North West	Azerbaijan	Early Bronze Age	Sheikhi & Mashkour	in prep.	IKT	6206
Büyüktepe Höyük	Turkey	North East	Bayburt Plain	Iron Age	Howell-Meurs	2001	TBH	923
Sos Höyük	Turkey	South East	Pasinler Valley	Iron Age	Howell-Meurs	2001	TS1	2556
Horum Höyük	Turkey	South East	along the Euphrates	Early Iron Age	Bartosiewicz	2005	TH1	277
Horum Höyük	Turkey	South East	along the Euphrates	Bronze Age	Bartosiewicz	2005	TH2	2003
Tilbeşar	Turkey	South East	North west of Gaziantep	Early/middle Bronze Age	Berthon & Mashkour	2008	TTb	1916
Kurban Höyük	Turkey	South East	Euphrates Valley	Early Bronze Age	Wattenmaker	1987	TKH	1236
Sos Höyük	Turkey	South East	Pasinler Valley	Early Bronze Age	Howell-Meurs	2001	TS2	2762
Arsilantepe	Turkey	South East	Malatya	Early Bronze Age	Bartosiewicz	1998	TAT	3836
Gritille	Turkey	South East	Euphrates Valley	Early Bronze Age	Stein	1987	TGR	1178

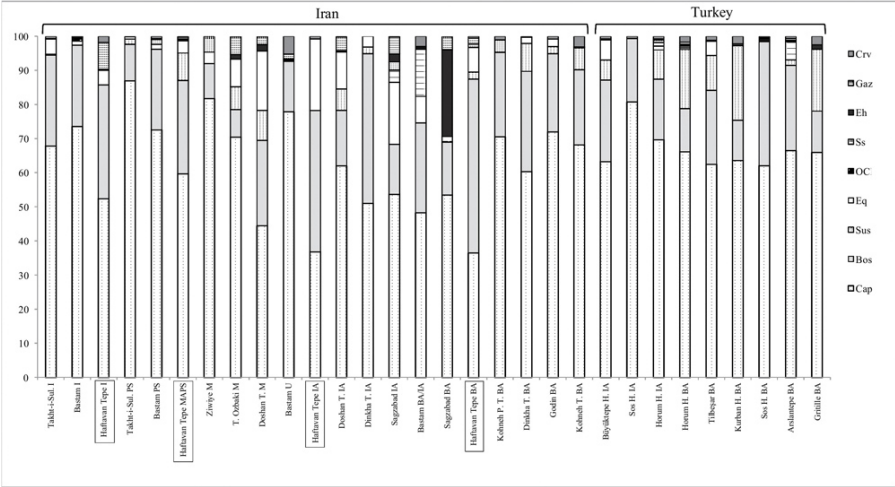


Fig. 11.14. Top: archaeological sites in the northwest of Iran and southeast of Turkey used to compare with Haftavan Tepe. Bottom: distribution of principal species in Iranian and Turkish archaeological sites. BA = Bronze

Age, IA = Iron Age, U = Urartian, M = Median, A = Achaemenid, P = Parthian, S = Sasanian and I = Islamic.

In order to eliminate the effect of overwhelming contribution of caprines, we decided to consider this group as an illustrative variable. In this analysis, the sites are mainly classified in six different groups.

The two groups of domestic equids and suids seems to be separated highly in the factorial plan, around which appear the sites with the high contribution of these animals: Sagzabad with a high percentage of equids and three Turkish sites of Kurban Höyük, Horum Höyük and Gritille with a high percentage of suids, all belong to the Bronze Age.

The four other groups are classified together because of different characteristics and various reasons. Between the two groups of domestic equids and suids, the three Iranian sites in the north of Central Plateau, Doshan Tepe (Iron Age), Doshan Tepe (Median) and Tepe Ozbaki (Median) are grouped together because of a relatively similar contribution of equids, suids and also bovines.

Haftavan Tepe during the Iron Age has a high percentage of bovines and a relatively high contribution of equids. The more or less same characteristics in the Bronze/Iron Age of Bastam located near Haftavan Tepe and Sagzabad make a single group of these three sites.

The relatively high contribution of bovines followed by suids in the historical period of Haftavan Tepe (MAPS) is the main characteristic which one could observe in the Iranian sites of Takht-i-Suleiman (Parthian/Sasanian), Kohnah Pasgah Tepesi and Dinkha Tepe (Bronze Age) all located in Azerbaijan near Haftavan Tepe and the Turkish sites of Büyüktepe Höyük, Horum Höyük (Iron Age) and Tilbeşar (Bronze Age).

During the Bronze Age of Haftavan Tepe, the percentage of bovines is the highest. During the Early Islamic period of this site also, there is a high contribution of cattle but the position of this site in the factorial plan is affected by the highest percentage of gazelle. The domination of bovines is the main characteristic of all of the sites situated in this group: Kohnah Pasgah Tepesi and Dinkha Tepe (Iron Age), Takht-i-Suleiman (Late Islamic), Ziwiye (Median), Bastam (Urartian, Parthian, Sasanian and Islamic) finally Godin Tepe (Bronze Age). In this group, all of the Iranian sites except for the latter are situated in Azerbaijan. This phenomenon may characterise the domination of bovines in this region. There are also two Turkish sites in this group: Arslantepe and Sos Höyük (Early Bronze and Iron Age).

In this analysis we observe that there is no chronological structure and the grouping of sites is mostly according to ecological,

geographical and practical (such as hunting and herding) factors.

In order to have a better understanding of this structure, there is the possibility to have a hierarchical classification directly based on the FCA analysis (Fig. 11.16). The result is more or less the same as FCA analysis, which means that there appears no chronological structure. It represents firstly the hunting and herding activities and secondly the ecological structure of the sites.

Haftavan Tepe during all of its periods is characterised by the high contribution of bovines. During the historical periods (MAPS), Haftavan is situated a little far from the other periods of this site, which is the affect of the highest contribution of suids in this period. The sites in which the wild species are abundant, Ziwiye, Bastam, Sagzabad and Arslantepe, are located in the hunting area. The two different areas for hunting which are located opposite to each other demonstrate the ecological differences: humid and arid environments. All of the other sites have more important herding strategies in comparison to hunting. The position of the sites in hierarchical classification depends to the abundance and the scarcity of each animal in related region.

Globally, the exploitation of domestic suids seems to characterize the Turkish sites and the high contribution of bovines the Iranian sites, mostly in its northern part.

Conclusion

Haftavan Tepe faunal remains have shown an important potential for the reconstruction of subsistence economy during the Early Bronze Age through to Islamic period in northwestern Iran.

The analysis of the faunal remains recovered in Haftavan Tepe indicates that the population of the site independently of the period of occupation did not rely on hunting. Cattle is obviously the principal base of the subsistence for all periods. This feature is combined with other archaeological data (extended architectural remains, a very important pottery production, the favorable ecological location of the site and resource availability, etc.). The reliance on domesticates and agriculture, which was highly suggested by the age profiles and bone pathologies are all indicative of an agro-pastoralist sedentary population.

Although the proximity of Lake Urmia to the site can be a food resource, the absence of fish and the scarcity of bird remains are noticeable, even in the absence of sieving during the excavation.

Among the osteological remains, human bones were identified in the Middle and Late Bronze Age levels. This was rather unexpected

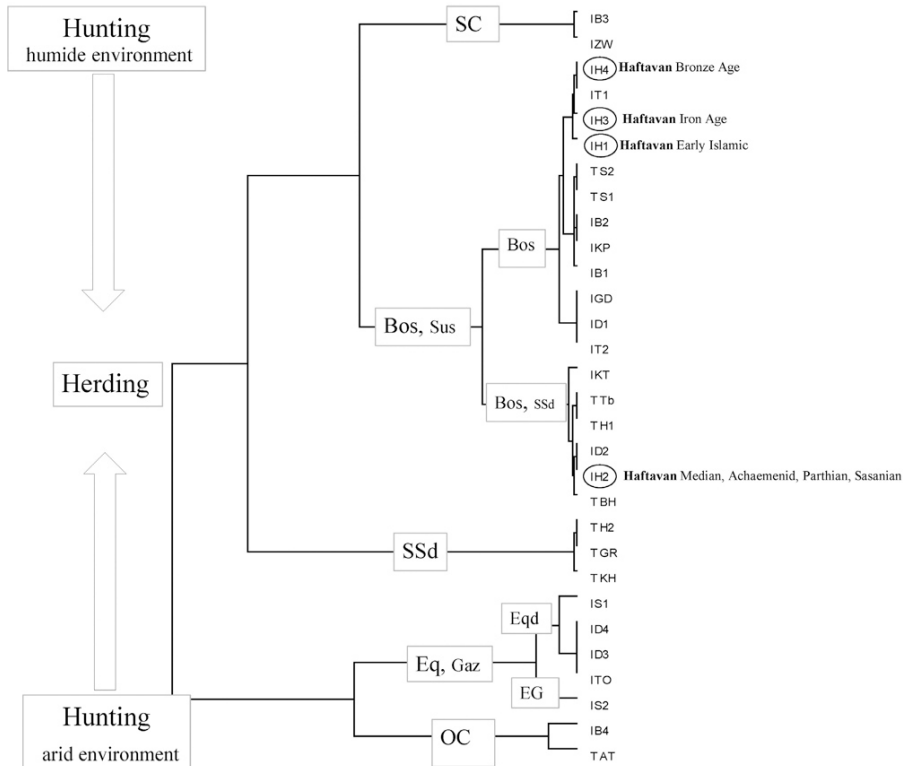


Fig. 11.16. Hierarchical classification of all examined sites of Iran and Turkey based on the FCA analysis (*Cap* = illustrative).

Also, it should be noted that despite the fact that the Iron Age period in Haftavan Tepe is very well represented archaeologically, it is much less represented in faunal remains. Thus, further archaeological excavations seem necessary to augment the available data mainly to understand the connection between the Bronze Age and the historical periods.

The characterisation of the subsistence economy of Haftavan Tepe and adjacent sites in Iran and Turkey shows a dichotomy in the orientation of the subsistence towards hunting or herding and influence by local environmental conditions. The situation of Haftavan Tepe shows the low importance of hunting in all periods of its occupation. Domestic cattle is essentially represented in the Bronze Age, Iron Age and Early Islamic period but in the historical periods the cattle and pig contribute to the diet. The high contribution of cattle in Haftavan Tepe, not only shows the exploitation of this animal as the main food source, but also represents the development of agriculture by practicing draught animal. This phenomenon is confirmed by traces of pathology on the extremities. The high

representation of cattle in almost all periods of occupation in this site leads us to conclude that Haftavan Tepe was a sedentary occupation during all of its periods.

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Note

- 1 Age profiles were performed following the protocol initiated by Helmer and Vigne, reproduced in Bréhard (2007).

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12. Animal exploitation in the Upper Tigris river valley during the Middle Bronze Age: a first assessment from Hirbemerdon Tepe

Rémi Berthon

Knowledge on the Bronze Age of the Upper Tigris Valley has dramatically increased in the last years due to numerous excavations linked with the Ilisu dam reservoir salvage project. However, most of the animal remains from this period are not yet analysed. Therefore, the economic and social patterns inherent in the exploitation of animal products are missing for this period. The purpose of this paper is to present the faunal remains from Middle Bronze Age (first half of the 2nd millennium BC) contexts from the site of Hirbemerdon Tepe. The broad patterns of domestic mammal exploitation, as well as the unusual exploitation of red deer, are described.

Keywords southeastern Anatolia, Upper Tigris Valley, Middle Bronze Age, Hirbemerdon Tepe, Red deer exploitation

Introduction

The Upper Tigris river valley is located in the interface between Anatolia and northern Mesopotamia. This region has recently been the subject of several archaeological projects related to salvaging the archaeological heritage of the Ilisu Dam Reservoir. Analysis of the faunal remains from Hirbemerdon Tepe started in 2007¹ (Laneri *et al.* 2008, 195–200). The site, with an extension of about 10ha, is located along the right bank of the Upper Tigris river valley, about 40km east of the modern town of Bismil in Diyarbakır province, Turkey (Fig. 12.1). The hinterland is characterised by both broad and cultivable

river terraces and rugged uplands better suited for grazing (Laneri *et al.* 2008, 101). Archaeological excavations have been carried out in the ‘Out Town’, the ‘Lower Town’ and the ‘High Mound’. The results indicate that Hirbemerdon Tepe was occupied during the Chalcolithic, Middle Bronze Age, Iron Age and Medieval periods (Laneri 2006; Laneri *et al.* 2006; 2008; 2009; 2015).

Material and methods

This report will focus on the Middle Bronze Age² (thereafter MBA) faunal assemblage excavated from the ‘Architectural Complex’ on the High Mound (Area A) during the 2005–2007 seasons (Fig. 12.2). This assemblage represents 2160 of the 3592 remains recorded in the project database. All the homogeneous MBA contexts of the ‘Architectural Complex’ will be considered together (for context-related differences, see Laneri *et al.* 2015). The specimens have been counted, weighed and assigned to a skeletal part and identified to species level wherever possible. Since the remains studied so far stem from hand-collected deposits, this assemblage is suitable for a discussion of the part and use of the medium (i.e. dog, sheep, goat or pig) and large (i.e. cattle, horse or red deer) mammals in the MBA ‘Architectural Complex’ of Hirbemerdon Tepe.

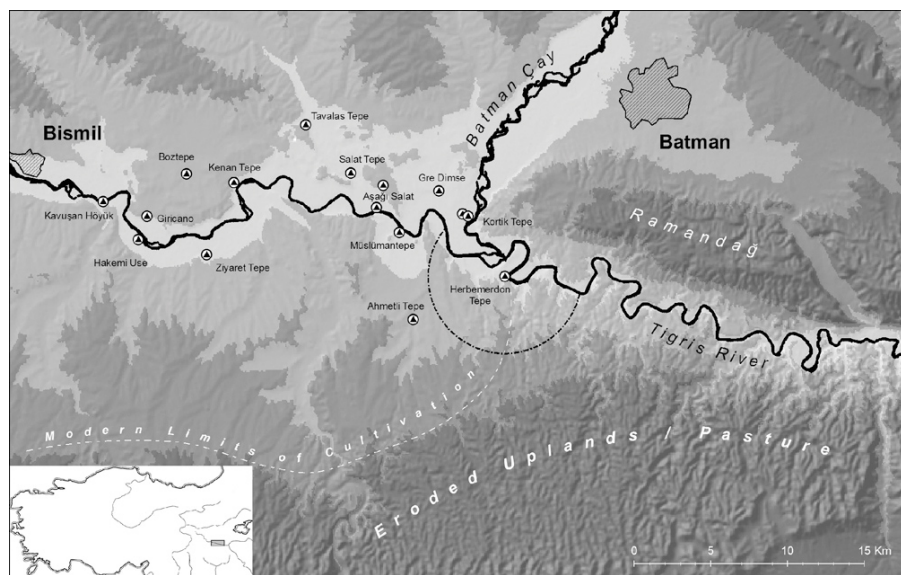


Fig. 12.1. The Upper Tigris river valley with excavated sites and the 5km radius Hirbemerdon Tepe catchment area. Courtesy of Dr Jason Ur, modified by R. Berthon.

Presentation of the assemblage

The remains were grouped according to different taxonomic groups and the results are presented in Number of Remains (NR), Number of Identified Specimens (NISP), Weight of Remains (WR), Weight of Identified Specimens (WISP) and Minimum Number of Individuals (MNI). The MNI method used is ‘de fréquence’ (Poplin 1976, 62), meaning it is based on the most frequent skeletal part by species without matching nor individualisation. It has only been calculated for mammals as investigations on other taxa are still in progress. Shed antlers are not included in the calculations as they are considered as raw material and may not reflect the actual presence of the species in the settlement or in its vicinity.

Among the assemblage discussed here, 1069 remains, weighing almost 28kg, were identified at least to the family taxonomic level and as a skeletal part (Table 12.1). They represent 49.6% of the NR and 72.9% of the WR. The unidentified remains are mainly small fragments with a mean weight of 9.5g per fragment (4.5g for the mediumsize mammals and 15g for the large mammals) against a mean weight of 26g per identified remain. Mammals represent 97.1% of the NISP and 99.4% of the WISP. As the identification of the non-mammalian taxa is still underway, they will not be discussed here.

Table 12.1. Representation of the taxonomic classes in the assemblage in Number of Remains (NR) and weight of Remains (WR).

	NR	WR (g)	%NR	%WR
Mammalia*	1.038	27.694	97.1	99.4
Aves	2	2	0.2	<0.1
Reptilia	8	78	0.7	0.3
Ichthyofauna	4	31	0.4	0.1
Mollusca	17	66	1.6	0.2
Total identified	1.069	27.871	100	100
Identified	1.069	27.871	49.6	72.9
Unidentified	1.087	10.357	50.4	27.1
Total	2.156	38.228	100	100
Total	2.156	38.228		
Dama sp. shed antlers	1	145		
Cervus elephus shed antlers	3	889		
Total	2.160	39.262		

*shed antlers excluded

The identified portion

Carnivora

CANIDAE

Specific determination is difficult among the species of this genus (i.e. the domestic dog *Canis familiaris*, the wolf *Canis lupus* and the golden jackal *Canis aureus*), particularly without a large sample of measurable bones. Nonetheless, in this assemblage, there is no morphological or metrical evidence for the presence of another species other than domestic dog. Therefore, all Canidae remains are allocated to *Canis* cf. *familiaris*. There is no evidence, such as the presence of cut marks, or of any use of their meat. Domestic dogs represent 2.1% of the NISP and are also attested by gnawing marks on 1.7% of the remains of this assemblage (Table 12.2).

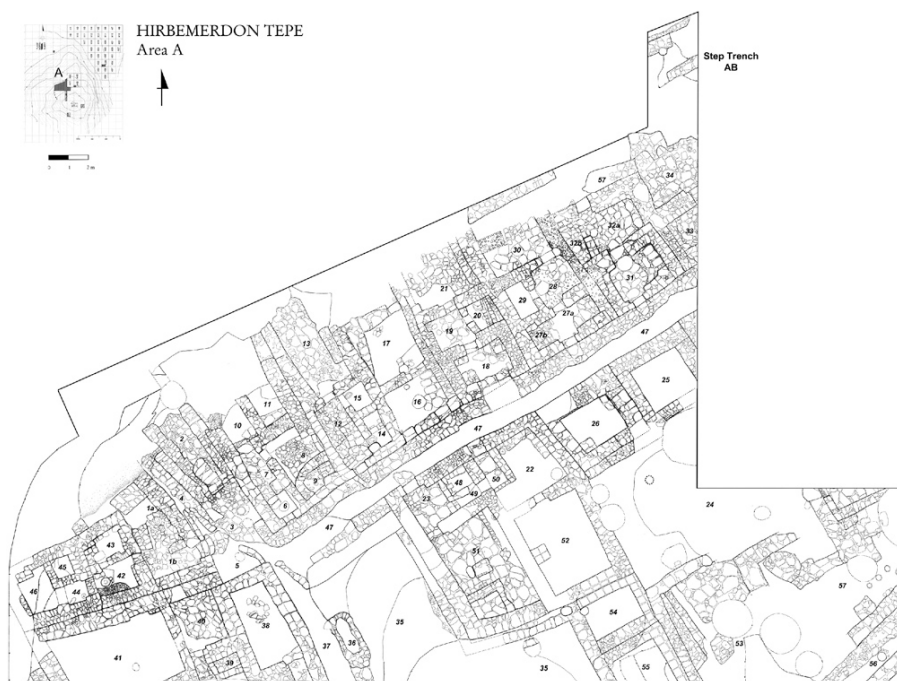


Fig. 12.2. ‘Architectural Complex’ of the Middle Bronze Age located in the High Mound (Area A). Courtesy of the Hirbemerdon Tepe Archaeological Project Director, Dr Nicola Laneri).

Table 12.2. Representation of mammalian taxa in the assemblage in Number of Identified Specimens (NISP), Weight of Identified Specimens (WISP) and Minimal Number of Individuals (MNI).

	NISP	WISP (g)	MNI	%NISP		%WISP		%MNI	
<i>Canis cf. familiaris</i>	22	144	2	2.1	2.7	0.5	0.7	3.5	4.3
<i>Equus</i> spp.	21	874	5	2.0	2.6	3.2	4.5	8.8	10.6
inc. <i>Equus cf. caballus</i>	3	260	1	0.5	0.6	0.9	1.4	1.8	2.1
inc. <i>Equus cf. asinus</i>	12	532	14	1.2	1.5	1.9	2.8	7.0	8.5
<i>Sus domesticus</i>	233	4,360	15	22.5	28.3	15.7	22.7	26.3	31.9
<i>Bos taurus</i>	205	9,945	8	19.8	24.9	35.9	51.7	14.1	17.0
Caprinae	342	3,930	17	32.9	41.5	14.2	20.4	29.8	36.2
inc. <i>Capra hircus</i>	64	1252	8	6.2	7.8	4.5	6.5	14.0	17.0
inc. <i>Ovis aries</i>	68	959	9	6.6	8.3	3.5	5.0	15.8	19.1
Total domestic animals	823	19,253	47	79.3	100	69.5	100	82.5	100
<i>Sus scrofa</i>	10	323	2	1.0	4.6	1.2	3.8	3.5	20
Cervidae*	203	8,081	6	19.5	94.4	29.2	95.7	10.5	60
inc. <i>Cervus elephus</i> *	166	5,935	6	16.0	77.2	21.4	70.3	10.5	60
<i>Capra aegagrus</i>	1	29	1	0.1	0.5	0.1	0.4	1.8	10
<i>Ovis orientalis</i>	1	8	1	0.1	0.5	<0.1	0.1	1.8	10
Total wild animals	215	8,441	10	20.7	100	30.5	100	17.5	100
Total mammals	1,038	27,694	57	100		100		100	
<i>Dama</i> sp. shed antlers	1	145							
<i>Cervus elephus</i> shed antlers	3	889							

*shed antlers excluded

Perissodactyla

EQUIDAE

Possible species occurring at the site, in terms of zoogeographic distributions and chronological evidence, are domestic horse *Equus caballus*, domestic donkey *Equus asinus*, onager *Equus hemionus*, and hybrids. The small number of each skeletal part does not help to interpret the osteometric and morphological criteria used to distinguish the different species (Boessneck 1987, 139, 142; Dive & Eisenmann 1991; Eisenmann 1980; 1986; Eisenmann & Beckouche 1986; Eisenmann & Mashkour 2000; Helmer 2000b, 235–237; Uerpman 1986; 1991; Vila 1998, 59–65). Based on bone morphology and size, the remains have been split into three categories: donkeys and the skeletal remains of the same size³ (*Equus cf. asinus*), horses (which includes possible inter-bred animals of the same size, regrouped under *Equus cf. caballus*), and finally, the remains for which a specific determination was not possible. The domestic horse specimens do not show any chop or cut marks and all belong to adult individuals. On the contrary, a domestic donkey femur was fractured and a domestic donkey talus shows a chop mark on its caudal side. This evidence of quartering does not prove human consumption of donkey meat. However, if it were the case, with 1.2% of the NISP and 1.9% of the WISP, consumption of donkey meat would have been very infrequent.

Artiodactyla

SUIDAE

Both pig *Sus domesticus* and wild boar *Sus scrofa* forms are present. The distinction between the two species is based on size, using a log ratio method with reference to measurements taken from modern Anatolian wild boar (Payne & Bull 1988). Specimens which were not suitable for this osteometric analysis, none of them being particularly large, were regrouped with the domestic pigs. Concerning the slaughtering age for the pigs, dental eruption and wear (Grant 1982; Horard-Herbin 1997, 140) indicates that half of them were killed between the age of 6 months and 1 year (Fig. 12.3).

Cervidae

The remains of deer are unexpectedly numerous in this assemblage. Both bones and antlers were recovered. As mentioned above, shed antlers were considered as raw material and were not counted as part of the wild game hunted in the vicinity of Hirbermerdon Tepe. This decision was motivated by the presence of several worked antlers (see below). It has not been possible to determine all the Cervid remains to species level. However, based on osteometric (Boessneck & Driesch von den 1975, 127–129; 1995) and morphological (Di Stefano 1996; Lister 1996) criteria, only red deer *Cervus elaphus* has been identified in this MBA assemblage. This species was common during the Neolithic period in the Upper Tigris and Batman river valleys (Arbuckle & Özkaya 2006, table 3; Rosenberg *et al.* 1998, 32; Starkovich & Stiner 2009, table 3). It is likely that it was still the case during the MBA. Most of the red deer remains belong to adult individuals with the exception of two mandibuls with deciduous premolars, two unfused medial phalanges, two unfused proximal phalanges, an unfused distal scapula, and an unfused distal metacarpal. More than 90% of the observed epiphyses are fused. It is also important to estimate the sex ratio in order to evaluate the hunting strategy. Three unshed antlers indicate hunting of male individuals. On the contrary, no female frontal bone has been seen. Using the Logarithm Size Index (LSI) method (Meadow 1999) with metrical data from Körtik Tepe and Çayönü, Arbuckle suggests that a gap at 0.06 in both assemblages would represent the border between male and female individuals (Arbuckle & Özkaya 2006, 123, fig. 10). Using the same modern female from northwestern Turkey as standard animal (Ilgezdi 2000, appx 1), the metrical data from MBA Hirbermerdon Tepe shows a small peak at 0.06 and a gap at 0.09 (Fig. 12.4). Sorting the male from the female would imply that all the bones show the same sexual dimorphism. This is not the case in some Bovid species like ibex *Capra ibex* (Fernández & Monchot 2007) or

mouflon *Ovis ammon* (Monchot 1999) and one can expect that it would not be the case with Cervids either. However, the presence of both male and female is indicated by the spread of the LSI value from -0.08 to 0.14.

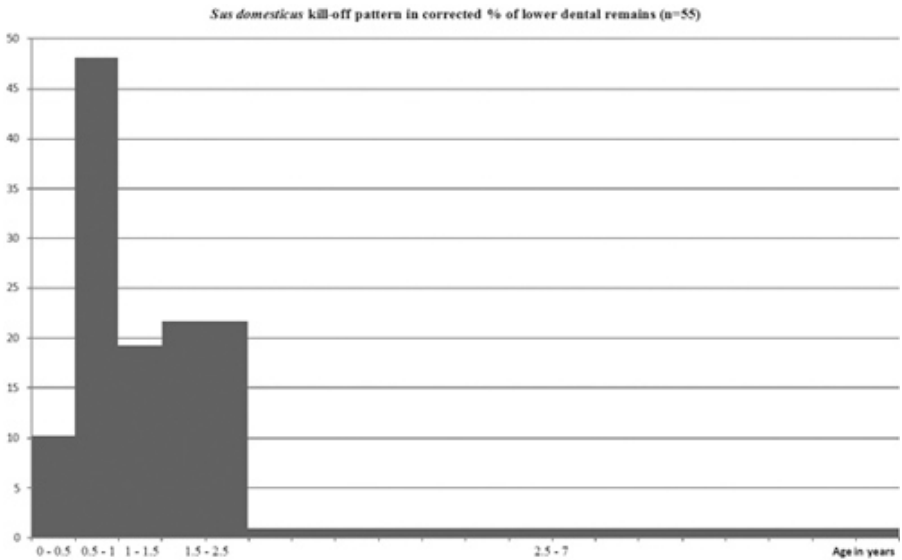


Fig. 12.3. Kill-off pattern for domestic pigs *Sus domesticus* in corrected percentage of lower dental remains (n = 55).

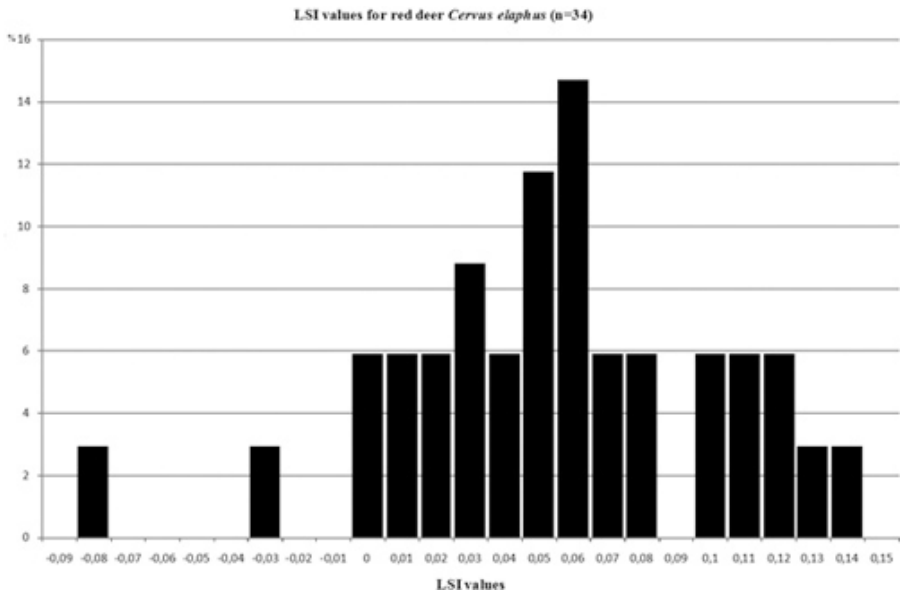


Fig. 12.4. Histogram showing distribution of LSI values for red deer *Cervus elaphus* (n = 34).



Fig. 12.5. Mesopotamian fallow deer *Dama mesopotamica* shed antler.

A shed antler (Fig. 12.5) has been determined as a Mesopotamian fallow deer *Dama mesopotamica* (Bubenik 1959; Haltenorth 1959). However, this species is not represented by a single postcranial remain in the assemblage and there is no evidence that this shed antler came from the vicinity of Hirbemerdon. Fallow deer are extremely rare in faunal assemblages of the Upper Tigris region. Some specimens have been assigned to the genus *Dama* in the Neolithic sites of Körtik Tepe (Arbuckle & Özkaya 2006, table 3), Hallan Çemi (Rosenberg *et al.* 1998, 33; Starkovich & Stiner 2009, table 3) and Çayönü (Hongo & Meadow 2000, table 4a) but they never contribute to more than 2% of the identified mammals.

Bovidae

BOVINAЕ

According to the size and morphology of the remains, domestic cattle *Bos taurus* is the only Bovine represented in the MBA Hirbemerdon Tepe assemblage. The kill-off pattern based on dental remains (Fig. 12.6) shows two small peaks at 2–4 years and at 9–11½ years old. The first group represents the main production of meat while the second group could be composed of individuals who have been kept for other purposes (such as reproduction, milking, draught animal, etc.) before consumption.

Caprinae

The determination of sheep *Ovis* from goat *Capra*, has been made using common morphological and metrical criteria (Balasse & Ambrose 2005; Boessneck 1969; Boessneck *et al.* 1964; Clutton-Brock *et al.* 1990; Fernández 2001; 2002; Halstead *et al.* 2002; Helmer 2000a; Helmer & Rocheteau 1994; Kratochvil 1969; Payne 1969; 1985; Prummel & Frisch 1986). Not all specimens can be determined to species. It has been possible to assign 38% of the Caprinae remains to the *Ovis* or *Capra* genus. The ratio *Ovis*:*Capra* is close to 1:1. A distinction between domestic (*Ovis aries* and *Capra hircus*) and wild (*Ovis orientalis* and *Capra aegagrus*) forms was based on size. The LSI method (Meadow 1999) has been used with the reference measurements from modern Near East wild individuals published by Uerpmann and Uerpmann (1994, tables 12, 14). For the two genera, only the bones over the 2 σ interval were assigned to the wild form. The kill-off patterns on dental remains (Payne 1973; Vigne & Helmer 2007, table 1) are still under investigation. However, it seems that with the exception of the younger class (0–2 months), which is represented by one remain (i.e. 45% of the corrected number of lower dental remains) for the sheep and not represented for the goat, there is no sharp peak. Most of the animals were slaughtered between two and six years old (Figs 12.7 & 12.8).

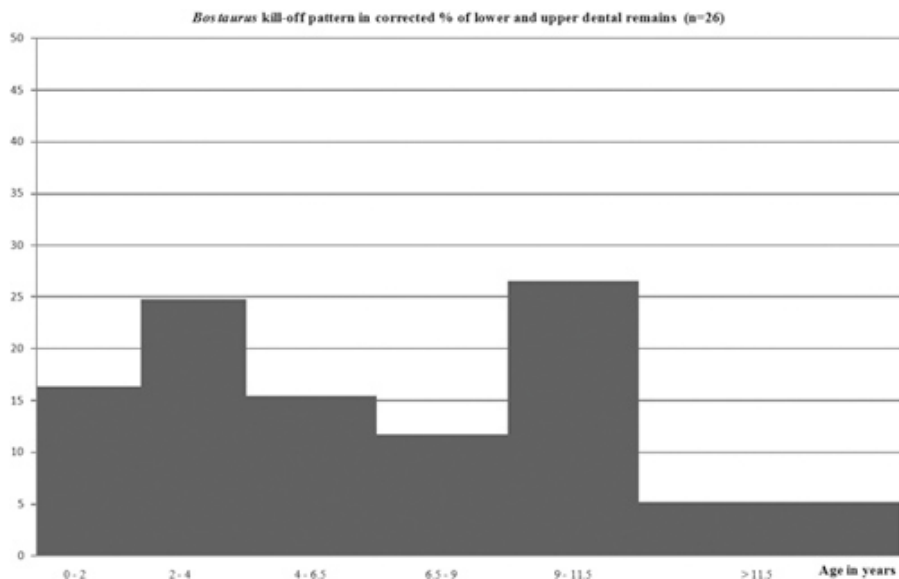


Fig. 12.6. Kill-off pattern cattle *Bos taurus* in corrected percentage of upper and lower dental remains (n=26).

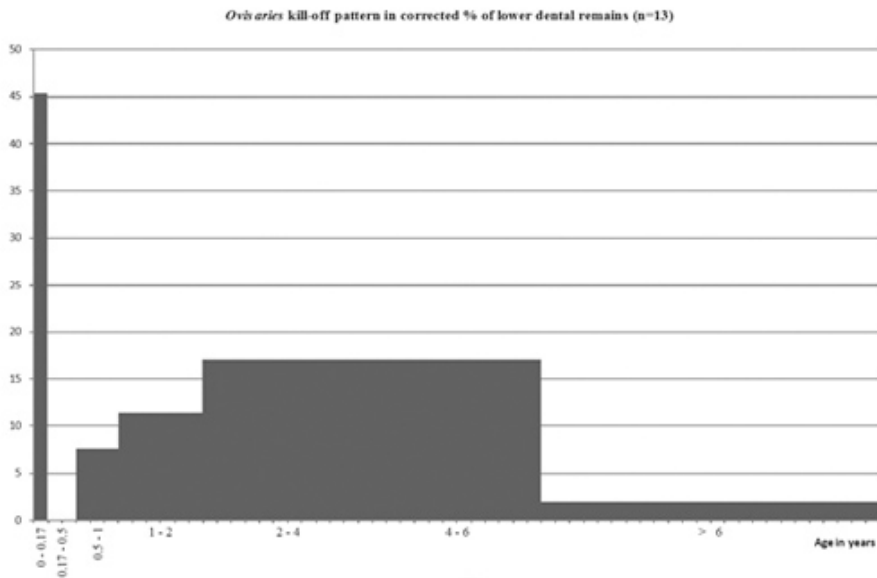


Fig. 12.7. Kill-off pattern sheep *Ovis aries* in corrected percentage of lower dental remains (n=13).

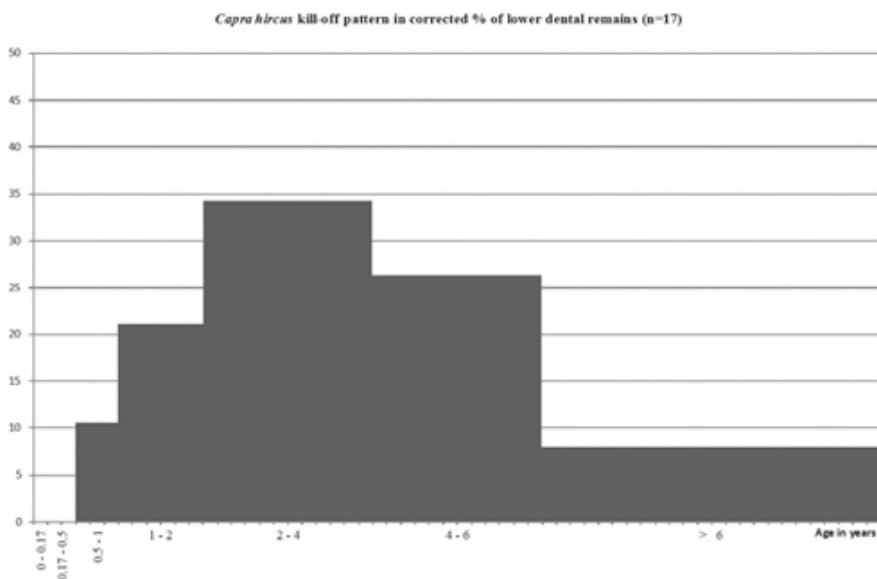


Fig. 12.8. Kill-off pattern goat *Capra hircus* in corrected percentage of lower dental remains (n=17).

Discussion

Mammal exploitation at MBA Hirbemerdon Tepe

Domestic mammals represent 79.3% of the NISP and 69.5% of the WISP. The major food-producing domestic mammals (sheep, goat, pig and cattle) represent almost 95% of both the NISP and WISP. Focusing on this ‘triad’ (sheep/goat, cattle and pig), the sheep and goat represent together almost 45% of the NISP (Fig. 12.9). They are followed by pigs (30%) and cattle (25%). WISP gives a better picture of the importance of each group in foodproducing economies (Uerpmann 1973, 310–311). Due to their size and weight, the quantity of products taken from a cattle herd is much more important than from the same number of sheep and goat. From an economic point of view, cattle were the most important mammal with 55% of the WISP, followed by pigs (25%) and sheep/ goat (20%). These animal however may have been kept for different reasons. Pigs are specific meat producers and were, unsurprisingly, consumed very young. It seems that sheep and goat were mainly slaughtered after they reached their optimum weight. The exploitation of milk and wool is also suggested. Cattle kill-off pattern show two peaks, one for individuals with a maximum meat return (2–4 years old), and another one for older individuals. However, all age classes are represented.

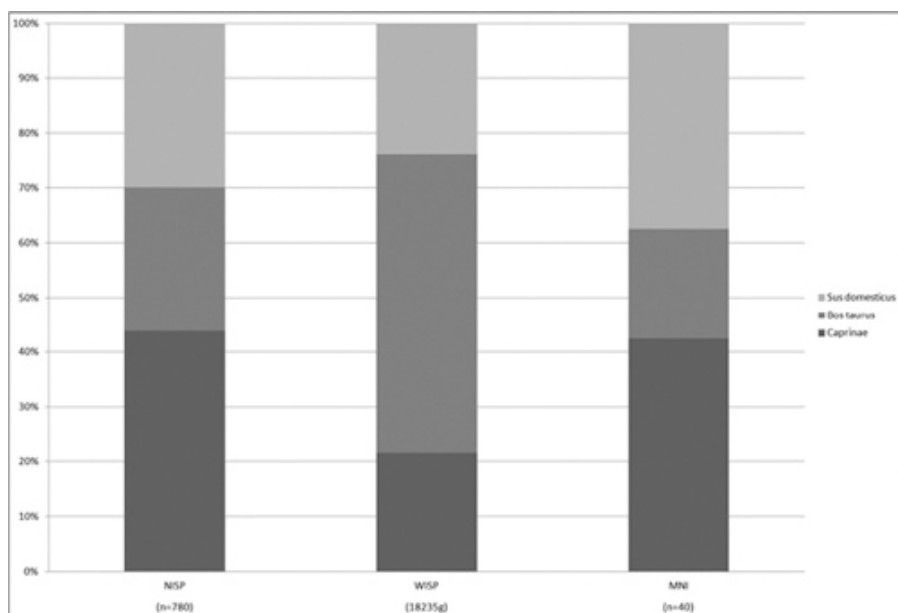


Fig. 12.9. Relative representation of the main domestic mammals in Number of Identified Specimens (NISP), Weight of Identified Specimens (WISP) and Minimal Number of Individuals (MNI).

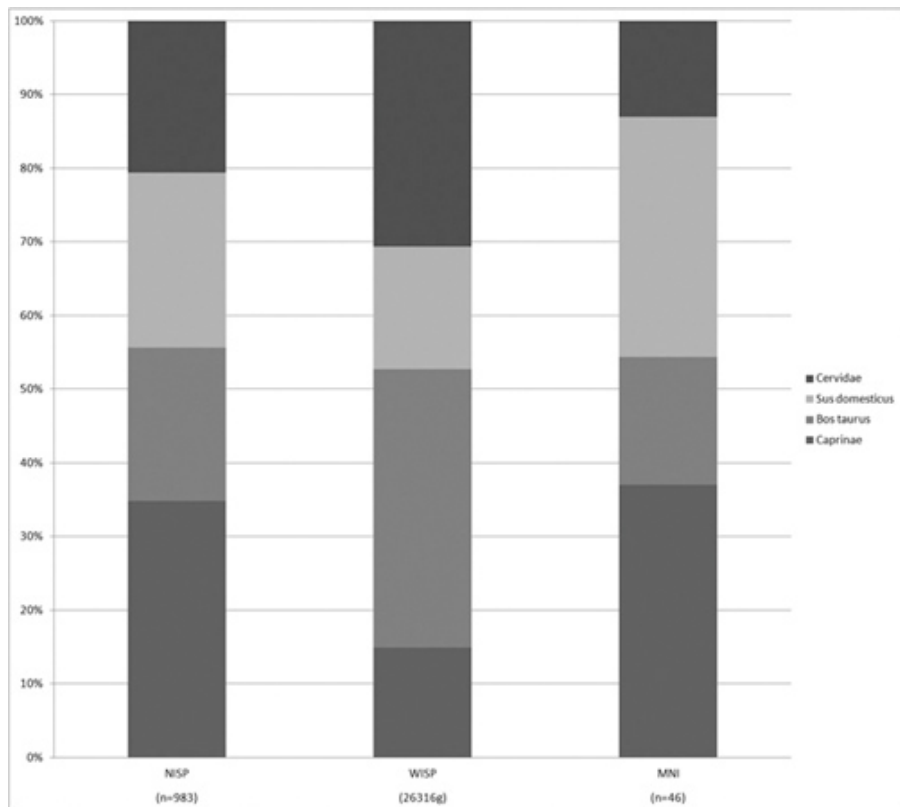


Fig. 12.10. Relative representation of the main food-provider mammals in Number of Identified Specimens (NISP), Weight of Identified Specimens (WISP) and Minimal Number of Individuals (MNI).

HUNTING

The presence of wild game in this assemblage is noteworthy. In fact, wild mammals are mainly represented by red deer *Cervus elaphus*, with all the other species contributing little to the assemblage. All these mammals could have been hunted for their meat. The hand-collection of the remains does not favour the recovery of hare, fox and other small game. However, it might not be the sole reason for the complete absence of these species in the assemblage. Hunting was focused on red deer which provided, among other products, a large quantity of meat. It is unlikely that the other wild species contributed significantly to the diet. Therefore, more than one motivation should be suggested for this activity. It could also, be for example, a leisure activity, an affirmation of social status, a cultural practice, protection of the fields (especially for wild boar), or just opportunistic hunting.

Red deer exploitation: Red deer is almost as important as cattle considering both NISP and WISP (Fig. 12.10). Therefore, its

exploitation was intentional and significant in the settlement economy. Red deer was one of the main meat providers. A preliminary survey of cut marks and skeletal representation attests to its consumption. Even if they are not yet clearly quantified, young and female individuals are present in the assemblage. The use of deer antlers (see hereafter) and the fact that shed antlers were also collected during the winter time tend to prove that the search for raw material was another important motivation for the hunting of red deer. However, it is not yet attested that older males with large antlers were preferentially hunted.



Fig. 12.11. Sawed proximal red deer Cervus elaphus metacarpal.



*Fig. 12.12. Unshed antler and skull of red deer *Cervus elaphus* showing work mark.*



Fig. 12.13. Red deer *Cervus elaphus* antler tine with chop marks.



Fig. 12.14. Red deer *Cervus elaphus* antler tine with sawing marks.

Social and cultural markers

The use of animals or animal resources in cultural activities is attested in MBA Hirbemerdon Tepe. A complete skeleton of a new born pig

(ca. 112 days after fertilisation according to Whenham *et al.*, cited in Prummel 1989) has been found in a fine cup (Laneri *et al.* 2008, fig. 8). It has been interpreted by archaeologists as a foundation ritual deposit within the ceremonial area (Laneri *et al.* 2008, 184).

Concerning the use of animal resources as raw material, only one bone – a proximal red deer metacarpal – shows saw marks (Fig. 12.11). All the other evidence for craft industrial activities involves the use of red deer antler. The MBA assemblage contains 27 antler remains. Among them, three are shed antlers and three others are unshed. One unshed antler shows chop marks on the skull and beam (Fig. 12.12). There are no work marks on the tree shed antlers. More than a third of the other antler remains show chop or saw marks (Figs 12.13 & 12.14). It is noteworthy that no finished object was recovered. Therefore, it is likely that part of the ‘architectural complex’ of Hirbemerdon Tepe was an antler craft industry centre during the MBA.

Conclusion

Analysis of faunal remains recovered from MBA contexts of the High Mound at Hirbemerdon reveals that the assemblage is mainly composed of butchery and meat consumption refuse. There is also clear evidence of the presence of an antler craft industry. The consumption of animal products was focused on – following their importance in Weight of Identified Specimens – cattle *Bos taurus*, red deer *Cervus elaphus*, domestic pig *Sus domesticus* and sheep and goat *Ovis aries/Capra hircus*. The exploitation of antlers in the craft industry confirms the importance of red deer. This focus on red deer seems to be a unique case in the region and was not seen, for example, in MBA Kenan Tepe (Berthon 2010). Red deer exploitation was therefore an economic strategy which might result from the geographical location of Hirbemerdon Tepe, closer to the foothills rather than to the other sites. On the contrary, the relative representation of the major domestic mammals – cattle, pig and sheep and goat – is pretty similar at Hirbemerdon Tepe and Kenan Tepe (Berthon 2010). At Hirbemerdon Tepe, the kill-off patterns suggest that pig were consumed young whereas the exploitation of sheep, goat and cattle was more distributed on the different age classes. Finally, animal consumption at MBA Hirbemerdon Tepe was less dependent on sheep and goat than contemporary settlements of Southeast Anatolia and northern Mesopotamia (Clason & Buitenhuis 1997; Clason 2000; Zeder 1998) even if the vicinity of pasture lands could have suggested the

contrary.

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Notes

- 1 The Hirbemerdon faunal assemblage is included in a PhD research, under the direction of Prof. Ulrich Müller and Dr. Marjan Mashkour, focused on the animal exploitation in the Upper Tigris river valley from the 3rd–1st millennia BC. This PhD has been completed and the final results were published elsewhere (Berthon 2011; 2013; 2015).
- 2 The radiocarbon dates range from 2010 to 1416 cal BC (Laneri *et al.* 2008, 179).
- 3 No equid specimen has been attributed to the onager.
- 4 The distinction between the European fallow deer *Dama dama* and the Mesopotamian fallow deer *Dama mesopotamica* is not always clear in southeastern Anatolia (Arbuckle & Özkaya 2006, 125).
- 5 In this case, a single remain for the younger class represents almost half of the dental remains in corrected percentages. It might be due to the effect of the class length correction applied to a small assemblage and therefore the importance of the younger class will not be commented in details here.

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13. Animal exploitation at Tell Bderi (Syria) during the Early Bronze period

Lubna Omar

The rescue excavation which was conducted at Tell Bderi site during the late 1980s until the early 1990s, revealed an Early Bronze Age town in the Khabur valley in the northeast of the Syrian Jazira region. This town is one of the largest among the group of settlements situated in the valley area, and it was continuously inhabited throughout the Early Bronze Age until the hiatus of occupation at the onset of the Middle Bronze Age. The natural settings of the settlement in a transitional area between the dry-farming and irrigation areas played a major role in determining the economical activities at the site. Examining the bone materials from the different levels, and the dwelling structures, provided us with an insight into patterns of wild and domestic resource exploitation in Khabur valley during the Early Bronze Age. At the same time we aim to demonstrate the affect of the environmental surroundings on the local diet, and the economic and cultural aspects of the daily life. The study of the subsistence base, which depended substantially on the herding strategies, enable us to enhance our interpretation of the socio-economical changes which occurred towards the last stages of the Early Bronze period and ended the occupation at the site.

Keywords Syria, Early Bronze Age, urban site, domesticates, agropastoralism

Introduction

The emergence of the Bderi settlement in the Khabur valley during the Bronze Age represents a new stage of human occupation in the northern Mesopotamia region. The Khabur basin in the northeastern corner of modern Syria is bordered by the Khabur River on the west (the largest tributary to the Euphrates), the Jaghjagh River on the east

side and on the north by the Taurus Mountains. It stretches further south until the Khabur joins the Euphrates River (Fig. 13.1). During the late 1980s the Syrian government initiated a project to construct irrigation channels, and three dams were built along the Khabur valley in the vicinity of the modern city of Hassake. This project generated extensive rescue excavations in the middle Khabur valley area including the archaeological investigation of Tell Bderi conducted by Berlin Free University team from 1985 to 1992 under the direction of Prof Hartmut Kühne with Prof Peter Pfälzner as the field director.

Aims of faunal analysis at Tell Bderi

During the past three decades the Khabur valley area was the subject of intensive archaeological investigations aiming to evaluate the ascending urban developments throughout the Bronze Age. The present study of the animal bone assemblages retrieved from different stratigraphical levels at Tell Bderi attempts to examine the patterns of animal exploitation at the settlement throughout the Early Bronze Age (EBA) phases, and thus the means of acquiring and distributing animal recourses. Another objective of this analysis is to reconstruct the environment surrounding the site in the Khabur region, and to define the role of the past environmental changes in the shaping and the development of human societies which inhabited the southern steppe of the Khabur basin.

Investigations into the economic basis at Tell Bderi will also help us to explain the role of the site within the Khabur basin region, and northern Mesopotamia as a whole. Several hypotheses have been formulated in an attempt to explain the emergence of urban settlements in the Khabur valley. Hole (1999a) proposed ‘the local land use theory’ which suggests that the Khabur valley towns served the pastoral herders who practised agriculture in the area during periods of favourable climate, while Fortin and Schwartz (Fortin 1998a; 1998b; Schwartz 1994) opposed him with their ‘export theory’ that interprets the presence of huge storage facilities within some of the small settlements along the Khabur river, as part of a well-organised distribution scheme of agricultural and livestock products toward the south or the north of Khabur valley. The examination of faunal remains from Tell Bderi aims to illustrate the patterns of animals use and disposal throughout the continuous phases of occupation at the settlement during the EBA, and to elucidate the position of the economic strategies at the EBA town within the framework of the proposed theories.

The site

Tell Bderi is considered as one of the largest Early Bronze Age settlements in the lower Khabur valley. The mound extends $300 \times 250\text{m}$ and it is surrounded by a mighty fortification wall. The size of the occupied area at the site is estimated to have been 4.6–6 ha. The excavated area consisted of two parts (Fig. 13.2): a step trench on the southern slope of the tell was excavated in order to examine the complete stratigraphical sequence of the settlement layers through the Bronze Age. The excavation area on the northern hill focused on horizontal exposure in order to investigate the main archaeological features of the settlement during the EBA (Pfälzner & Shaath 1986; Pfälzner 1990a; Pfälzner & Mahmoud 1986).

According to the Pottery sequence which could be obtained during the archaeological investigations at Tell Bderi, the earliest evidence of occupation at the site dates back to the 5th millennium BC, while the oldest excavated settlement layer belongs to the Uruk Period at the end of the 4th millennium BC. These early layers are followed by a continuous succession of EBA levels (Layer 27–8). The uninterrupted occupational levels of EBA covered the entire Early Dynastic Period in southern Mesopotamian chronology around (ca. 2850/2750 BC), until the last phases of the Akkadian Period (ca. 2250/2100 BC) (Table 13.1). According to Upper Mesopotamia chorological sequence the site was inhabited continuously from Early Jazirah II period until the end of Early Jazirah IV period (Table 13.1). The EBA sequence was about 10m in height at the step trench, followed by layers of the Late Bronze Age (LBA), which are separated from the EBA layers by an occupational hiatus during the Middle Bronze Age (MBA). The settlement must have been totally abandoned during the MBA period. Probably only one or just some houses existed somewhere on the top of the tell during this period.

A new intensive occupation started in Late Bronze Age at the time of the Hurri-Mittannian expansion in northern Mesopotamia during 15th and 14th centuries BC. Levels 5–3 belong to this period. The excavation areas on the northern hilltop showed the same chronological sequence. The occupation at Tell Bderi seems to have continued until the 12th century BC, when the settlement came to an end (Pfälzner 1990).

Table 13.1 Chronological sequence of the stratigraphical levels at Tell Bderi

<i>Early- Jazīrah</i>	<i>Bdēri</i>	<i>Southern Mesopotamia</i>	<i>Years BC</i>
		Ur III	2100–2000
IV	7–6	Mid–late Akkad	2250–2100
II–Ib	13–8	ED IIIb/early Akkad	2500/2400 – 2250
IIIa	20–14	ED IIIa/II	2700/2600–2500/2400
II	27–21	ED II	2850/2750– 2700/2600
		ED II/I	3000/2900– 2850/2750

There is evidence of monumental architecture at the site in the form of the massive town wall, which was constructed of mud bricks during the EBA and it reached more than 2.5m wide. It had an impressive orthostate gate. The whole structure was enforced by a glacis. Dwelling houses were excavated at several levels within the settlement. All the one-storey houses were built from mud bricks with roofs constructed from wooden beams and covered with straw and wood. The layout of these houses differed from one level to another. Some had simple layout while other formed a succession of courtyards and its doors had curved sides. LBA houses had a linear layout contrasting with the cluster layout which dominated the EBA (Pfälzner 2001).

Most of the finds at the settlement came from the dwelling areas within the houses. Several complete vessels and bowls were retrieved, some of which had food and drink remains inside them. Storage vessels and grinding stones were part of the recovered finds. A bronze sickle was found on the floor of one of the houses, while jewellery was scarce, and it seems that these items were locally manufactured (Pfälzner & Shaath 1986; Pfälzner & Mahmoud 1986). One of the important finds which gave an insight into musical activities of settlement's inhabitants is a shoulder blade of a cow with several parallel incisions at the lateral side of the scapula's neck.¹ The modifications applied on this skeletal element suggest the use of this object as part of a musical instrument (Becker *et al.* 1988; Pfälzner 1990b).

Faunal analysis

A preliminary study of the faunal remains from Tell Bderi retrieved

during the 1985 excavation was published by C. Becker (1988). The current study includes animal bones retrieved during the six excavation campaigns between 1985 and 1992. They come from the step-trench area, and the north hill trenches. All the bones were carefully hand-collected without sieving the excavated debris. The bones were washed, dried, and later the whole assemblage was exported to Tübingen University during the early '90s and is currently stored there. The assemblage consists of faunal remains excavated from the Early Bronze Age levels. This assemblage is utilised to reconstruct the patterns of animal exploitation throughout the different chronological phases at the site.

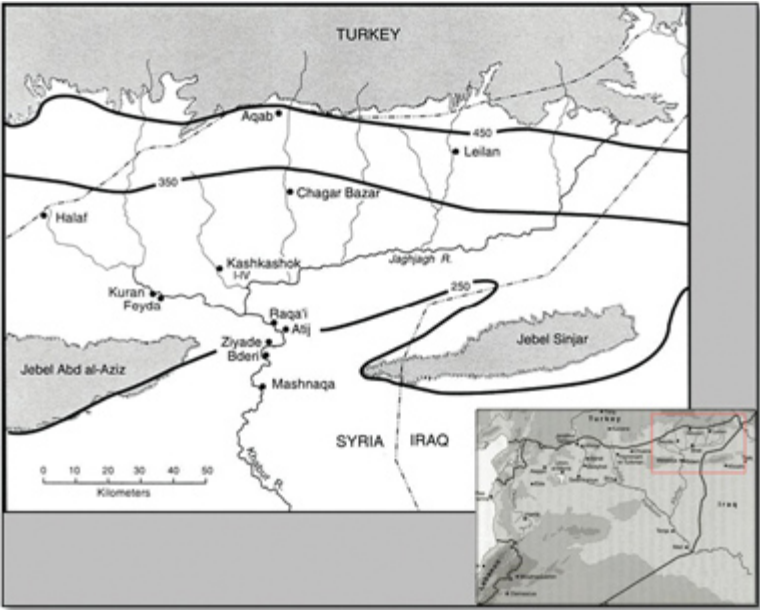


Fig. 13.1. Map of the Khabur valley area, and the major sites excavated within northeastern Syria.

Table 13.2 Relative abundance of species at Tell Bderi during the EBA period

<i>Identified Species</i>	<i>NIS</i>	<i>%</i>	<i>WIS</i>	<i>%</i>
Cattle (<i>Bos taurus</i>)	244	8.7	6620.5	20.4
Donkey (<i>Equus asinus</i>)	23	0.8	786.9	2.4
Sheep (<i>Ovis aries</i>)	585	20.7	4565.7	14.1
Goat (<i>Capra hircus</i>)	210	7.4	1650.1	5.1
sheep or goat (<i>Capra/Ovis</i>)	1174	41.6	5632.3	17.4
Pig (<i>Sus scrufa var.dom</i>)	2	0.1	31	0.1
Dog (<i>Canis familiaris</i>)	42	1.5	121.5	0.4
Aurochs (<i>Bos primigenus</i>)	4	0.1	509	1.6
Red deer (<i>Cervus elaphus</i>)	4	0.1	58.8	0.2
Mesopotamian fallow deer (<i>Dama mesopotamica</i>)	3	0.1	79.4	0.2
Roe deer (<i>Capreolus capreolus</i>)	1	0	12	0
Goitered gazelle (<i>Gazella subgutturosa</i>)	95	3.4	509.2	1.6
Asian wild ass (<i>Equus hemionus</i>)	105	3.7	4692.7	14.5
Equid (<i>E.hemionus/ E.asinus</i>)	289	10.2	7014.9	21.6
Fox (<i>Vulpes vulpes</i>)	0	0	0	0
Mid.size. Carnivore	7	0.2	39.7	0.1
Striped hyaena (<i>Hyaena hyaena</i>)	1	0	6	0
Hare (<i>Lepus capensis</i>)	5	0.2	4.5	0
Rodents	12	0.4	1.3	0
Birds	4	0.1	48.4	0.1
Fish	0	0	0	0
Molluscs	10	0.4	54.7	0.2
Total	2820	100	32,438.6	100

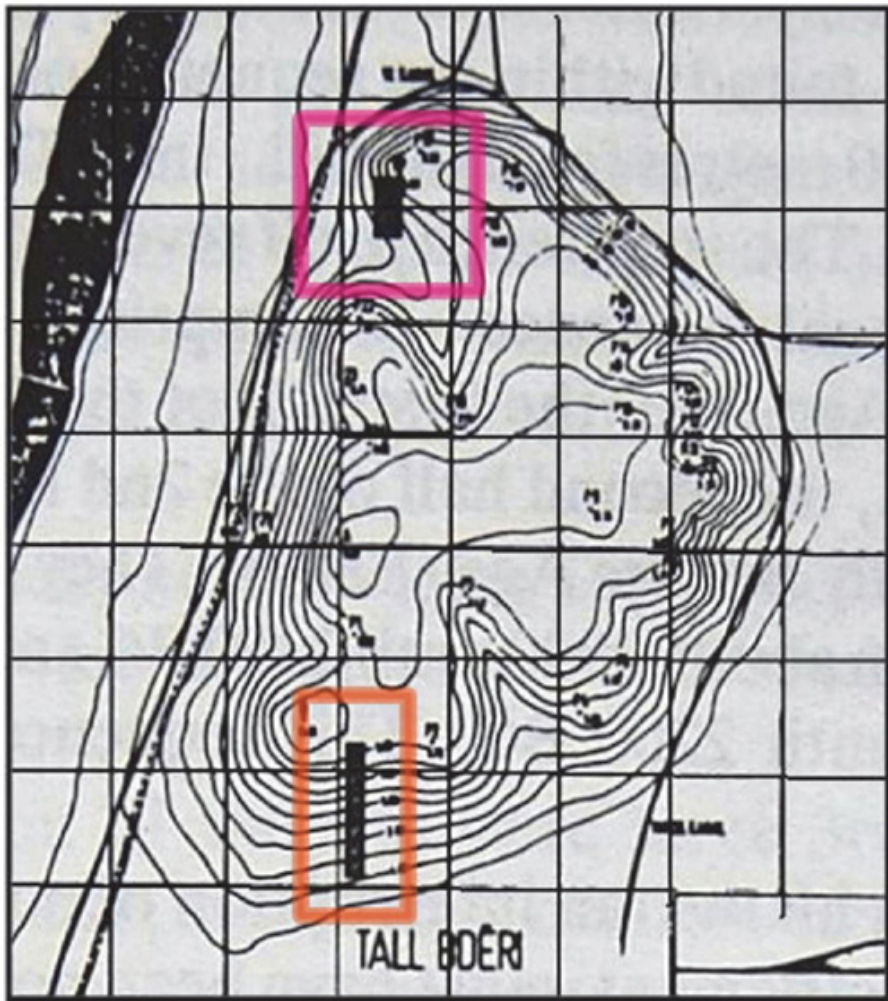


Fig. 13.2. Excavated trenches at Tell Bderi site.

Table 13.3 Relative abundance of species of the different levels of the EBA period at Tell Bderi

Levels	EJ II		EJ II-EJ IIIa		EJ III a		EJ IIIb		EJ IV	
Domestic species	NIS	WIS	NIS	WIS	NIS	WIS	NIS	WIS	NIS	WIS
Cattle (<i>Bos taurus</i>)	18	455.3	5	145.2	30	511.4	146	4646.5	45	862.1
Donkey (<i>Equus asinus</i>)	0	0	2	101	1	93	17	554.6	3	38.3
Sheep (<i>Ovis aries</i>)	74	493.7	10	78.8	113	938.7	320	2705.6	68	348.9
Goat (<i>Capra hircus</i>)	20	212	2	18	36	261.5	111	938.5	41	220.1
sheep or goat (<i>Capra/Ovis</i>)	73	340.9	30	142.2	221	1023.9	632	3246.9	218	878.4
Pig (<i>Sus scrofa</i> var.dom)	0	0	0	0	1	8	1	23	0	0
Dog (<i>Canis familiaris</i>)	0	0	0	0	3	27	38	93.5	1	1
<i>Wild species</i>										
Aurochs (<i>Bos primigenus</i>)	4	509	0	0	0	0	0	0	0	0
Red deer (<i>Cervus elaphus</i>)	0	0	0	0	2	26.2	1	28.6	1	4
Mesopotamian fallow deer (<i>Dama mesopotamica</i>)	0	0	0	0	0	0	3	79.4	0	0
Roe deer (<i>Capreolus capreolus</i>)	0	0	0	0	0	0	1	12	0	0
Goriated gazelle (<i>Gazella subgutturosa</i>)	26	107.8	1	3	15	74.6	47	315.4	6	8.4
Asian wild ass (<i>Equus hemionus</i>)	10	480	0	0	7	306.3	80	3535.2	8	371.2
Equids	29	555.5	13	437.2	26	446	158	4326.3	63	1249.9
Fox (<i>Vulpes vulpes</i>)	0	0	0	0	0	0	0	0	0	0
mid.size. Carnivore	1	0.2	0	0	2	8	4	31.4	0	0
Striped hyaena (<i>Hyaena hyaena</i>)	0	0	0	0	0	0	1	6	0	0
Hare (<i>Lepus capensis</i>)	0	0	1	1	0	0	3	3	1	0.5
Rodents	0	0	0	0	10	0.8	2	0.5	0	0
Birds	1	2	0	0	2	25	1	21.3	0	0
Fish	0	0	0	0	0	0	0	0	0	0
molluscs	2	5.7	0	0	1	3.7	3	16.1	4	29.2
Undetermined mammals	430	1691.1	292	697	533	1276.3	2254	6009.3	1535	3145.4
unidentified bones	61	145	0	0	105	105.4	347	321.3	445	421
Total	749	4998.2	378	1623.4	1108	5135.8	4170	26,914.4	2439	7578.4

Materials

Early Bronze Age faunal assemblage consists of 8822 fragments, totaling 46,250.4g in weight. The number of identified specimens (NIS) is used to evaluate the representation of animal species in the assemblage. The total number of faunal fragments is shown in [Table 13.2](#). Due to severe fragmentation of the studied assemblage only 32% (2820 out of 8822 fragments) of the whole collection was assigned to genera, species or family level. On the other hand 51.1% of the materials are classified into groups according to mammal size. Based on the NIS counts the category of middle-sized mammals (including sheep, goat, pig, gazelle, roe deer, dog) exceeds the large mammals (including cattle, donkey, onager, red deer) both among the identified and the unidentified animals ([Table 13.2](#)). Based on bone weight (WIS), however, large-mammal category comprises ca. 57.5% of the assemblage. Non-mammalian remains make up less than 1% of the identified sample. This group consists of birds, fish and mollusc remains. The under-representation of this category is possibly a result of the applied recovery methods of faunal remains and the taphonomical processes at the site, rather than reflecting the actual importance of fresh water fish, Mollusks and birds in the diet of Tell Bderi's populations.

Results of faunal analysis

Range of identified taxa

The relative abundance of taxa at the EBA settlement indicates a consistent representation of domestic animal remains throughout the

continuous occupational levels at the settlement. Domestic animal fragments comprised ca. 83% of NIS, and 64.9% of WIS of the assemblage (Table 13.3).

Domestic sheep and goat are the most abundant species in all phases both in numbers and weights. Especially in phase IIIa sheep and goat fragments comprise 79% of the total identified bones (Table 13.2). Sheep and goat provide a different set of primary and secondary products. Knowledge about the composition of sheep and goat herd at the site would provide us with a comprehensive insight on the economical potential of the exploited herd (Halstead *et al.* 2002a; Sherratt 1983). The osteological separation of postcranial caprine bones is based on the descriptions of morphological differences presented by Boessneck *et al.* (1964) and Halstead *et al.* (2002b), while the differences in mandibular teeth are registered according to the morphological characteristics discussed by Halstead *et al.* (2002a), Payne (1973), Deniz & Payne (1982). Fragments which could not be identified to *Ovis* or *Capra*; are grouped into the *Ovis/Capra* category. For final evaluation this unidentified *Ovis/Capra* category is divided according to the ratio of the identified fragments of the two species in each phase, and the resulting amounts are added to the identified *Ovis* and *Capra* category respectively (Table 13.4).

Table 13.4 Identified mammal counts and weight percentages within the EBA levels

Levels	EJ II		EJ II-EJ IIIa		EJ IIIa		EJ III b		EJ IV	
Domestic species	NIS%	WIS%	NIS%	WIS%	NIS%	WIS%	NIS%	WIS%	NIS%	WIS%
Cattle (<i>Bos taurus</i>)	7.1	14.4	7.7	15.7	6.4	13.7	9.3	22.6	9.9	21.6
Donkey (<i>Equus asinus</i>)	1.2	1.6	16.9	41.5	0.9	4	2.9	6.4	4.6	13
Sheep (<i>Ovis aries</i>)	51.4	24.2	53.8	21.3	60.8	46.4	50.5	24.9	44.3	22.3
Goat (<i>Capra hircus</i>)	14.1	9	10.8	4.5	18.4	13.3	17.4	8.6	27.4	14
Pig (<i>Sus scrofa</i> var. dom)	0	0	0	0	0.2	0.2	0.1	0.1	0	0
Dog (<i>Canis familiaris</i>)	0	0	0	0	0.6	0.7	2.4	0.5	0.2	0
Wild species										
Aurochs (<i>Bos primigenius</i>)	1.6	16.1	0	0	0	0	0	0	0	0
Red deer (<i>Cervus elaphus</i>)	0	0	0	0	0.4	0.7	0.1	0.1	0.2	0.1
Mesopotamian fallow deer (<i>Dama mesopotamica</i>)	0	0	0	0	0	0	0.2	0.4	0	0
Roe deer (<i>Capreolus capreolus</i>)	0	0	0	0	0	0	0.1	0.1	0	0
Goitered gazelle (<i>Gazella subgutturosa</i>)	10.2	3.4	1.5	0.3	3.2	2	3	1.5	1.3	0.2
Asian wild ass (<i>Equus hemionus</i>)	14.1	31.2	7.7	16.6	6.4	18.7	13.4	34.6	11.8	28.6
Striped hyaena (<i>Hyaena hyaena</i>)	0	0	0	0	0	0	0.1	0	0	0
Hare (<i>Lepus capensis</i>)	0	0	1.5	0.1	0	0	0.2	0	0.2	0
Other species	0.4	0	0	0	2.5	0.2	0.4	0.2	0	0

Cattle bone fragments formed 8.7% of the total number of identified species at the different levels of occupation during the EBA. We observed an increase in the counts of cattle during the end of the EBA phase as represented in Table 13.4. It reached its highest proportion in the Middle Akkadian period with approximately 9.9% of the identified species of Phase Early Jazirah IV. The increase in the number of cattle

suggests an alternation of the economical choices of the inhabitants possibly aiming to accelerate production, and distribution of cattle recourses.

The proportion of equid remains at Bderi forms more than 14% of the total of identified specimens (NIS), and 34.8% by weight (WIS) (Table 13.2). The substantial presence of equids at the site is a reason for investigating the role of equid exploitation in the economic system of the settlement. The first question is which species of the equidae family were present at the site or in the surrounding steppe. The presence of the domestic ass (*asinus*) is attested for several EBA settlements in northern Mesopotamia (Uerpmann 1987; Vila 1998; Boessneck & Kokabi 1981). The morphological separation of the ass remains from the other members of the equid family which inhabited northern Mesopotamia during the Bronze Age has remained a widely discussed problem (Boessneck & Kokabi 1981; Eisenmann, 1995; Vila 1998a; Helmer 2000; Uerpmann 1991). The separation of equid materials is based on the morphological characteristics of teeth and postcranial elements discussed by Uerpmann (1990, 22), Vila (1998, 139), and Boessneck (1987, 139, 142). Similar to the evaluation of sheep and goat species counts, equid fragments that could not be allocated to either hemione or *asinus* were divided between the two species based on hemione/*asinus* ratio of the well identified specimens in each level of the EBA period. According to the hypothetical proportions, the domestic ass provided 3% of the total identified bone fragments (NIS), and about 7.4% of the total weight (WIS; see Table 13.4). The number of domestic ass fragments increased considerably towards the end of the EBA period and comprised 4.9% of the total counts while, during the beginning of the EBA, the proportion of donkey bones is only around 1% of equid species at Tell Bderi. As for the domestic ass, the proportion of onagers is estimated based on hemione/donkey ratios of the well identified bones. The estimated hemione counts for the EBA levels show that wild onagers comprised 11.8% of the total number of identified species and more than 30% of the total weight. The proportion of hemione fluctuates throughout the EBA phases, but in general it demonstrates a decrease in both number and weight. The hunting of wild animals (onager, and gazelle) which inhabited the adjacent steppe, might be practiced by the agro-pastoral community at Bderi in order to protect the marginal agriculture, or to expand the pasture areas of small ruminant herds (O'shea 1989).

Another matter which should be taken into consideration is the potential presence of hybrids in the bone assemblage. The existence of equid hybrids during the Bronze Age is documented in early written

records (Ismail *et al.* 1996; Maekawa 1990; Oates 2003), but the identification of the hybrids among skeletal collections requires much better preservation of the bone fragments in order to evaluate the differences in proportions (Eisenmann & Beckouche 1986) or other morphological features. As with the hunted onagers the EBA agropastoral communities in northeastern Syria also depended on hunted gazelles as a supplementary source of meat, but in lesser numbers than the 4th millennium BC communities that settled in the Khabur valley region, before the emergence of the EBA urban communities. Based on the size and the morphology of the horn cores, gazelle remains present at Tell Bderi belong to *G. subgutrossa*, which formerly inhabited the desert and steppe areas in eastern Syria. Gazelle fragments amount to 3.4% of the total identified species counts (NIS), and to about 18% of all wild mammals bones from the site.

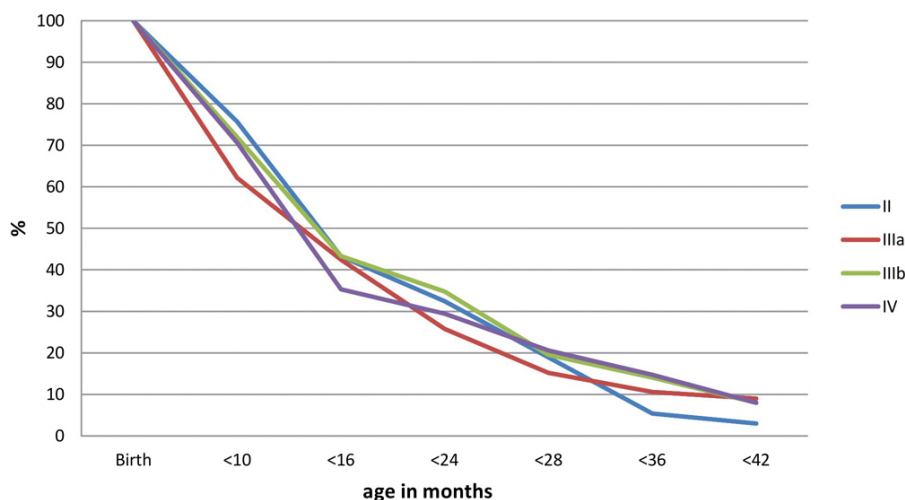


Fig. 13.3. Survival curves of sheep and goat based on fusing scores of postcranial elements.

A very small number of bones are assigned to *Cervus elaphus*, and the Mesopotamian fallow deer, *Dama dama mesopotamica*. One bone fragment belongs to the roe deer, *Capreolus capreolus*. These cervids probably inhabited the valley area between Jabal Seinjar and Jabal abd-alaziz during the Bronze Age period (Uerpmann 1987).

Only two bone fragments were identified as pig bones from EJ IIIa and IIIb. Dog bones were more abundant at different levels of the EBA settlement, and one of the retrieved femura had small cut marks. The small sample of bones did not permit us to really clarify to which

extent pigs and dogs contributed to the human diet at Bderi, but the small amount of bone finds in any case indicates that they were not important for the people who left their bone refuse within the excavated areas.

When it comes to the other wild animal taxa at the site, small number of Aurochs (*Bos primigenius*) vertebra were retrieved from the earliest phases of occupation. Hare (*Lepus* sp.) is the most represented small mammal at the site, and some of its remains had traces of burning, apparently as a result of food-preparation processes. One femur of a hyena (*Hyaena hyaena*) was found at layer 13 which dates back to the EJ IIb period. Several unidentifiable medium-sized carnivore bone fragments were also found, distributed throughout the different occupational levels at Bderi.

Ratios of domestic animals

Remains of domestic animals formed the majority of the faunal assemblage from Tell Bderi. Livestock of the ancient settlement consisted of sheep, goat, cattle, and donkey. Sheep and goats are the main exploited species at the site within the different levels of occupation. The evaluation of sheep and goat population within the chronologically defined phases at Bderi is based on the ratios of goat to sheep, which range between 1:3.7, 1:3.2 in EJ II and IIIa to 1:2.8 in the early Akkadian Period. During the last phase of EBA occupation the goat to sheep ratio drops to 1:1.6. The proportions of sheep and goat within Bderi assemblage seem to display a different pattern of sheep and goat husbandry compared with the herding techniques documented within the same phases in Tell Mozan located north of Tell Bderi (Doll n.d.). Goat to sheep NIS ratios at Mozan range between 1:1 and 1:2 during the EJ II period until the end of EJ IIIb period, then the proportion of sheep suddenly increases in EJ IV period to reach 1:10, this change in goat to sheep ratio is contemporary with the expansion of 3rd millennium city at Tell Mozan during the Middle Akkadian period (Buccellati 1998; Buccellati *et al.* 1998). The variation of sheep and goat ratios between upper and lower Khabur basin sites throughout the different phases on EBA obviously reflects differences in environmental setting of both regions, and the dependency on different sets of economical strategies regarding the control of sheep and goat herds in each settlement. Cattle are the third domestic animal present. According to the fragment counts cattle constituted about 10% of Bderi's livestock, and provided more than 30% of the meat weight. The proportion of cattle gradually increases during the EBA stages to reach its highest ratio

toward the beginning of the Early Akkadian period, while the proportions of sheep slightly decrease. Domestic animal proportions at the site suggest that livestock economy at Bderi depended mostly on the intensive exploitation of sheep and goat, with smaller numbers of cattle. The pattern of domestic animal exploitation at the settlement focused on the consumption of sheep and goat herd which is the most suitable domestic resource in consideration to the regional conditions, however, the last phases of EBA demonstrate an increase in the importance of cattle at the settlement, and this notable shift in cattle numbers could be recognized as an aspect of urban development in the direction of complex socio-cultural centre, which depended on a wider range of animal products (Clason & Buitenhuis 1997; Hesse 1990).

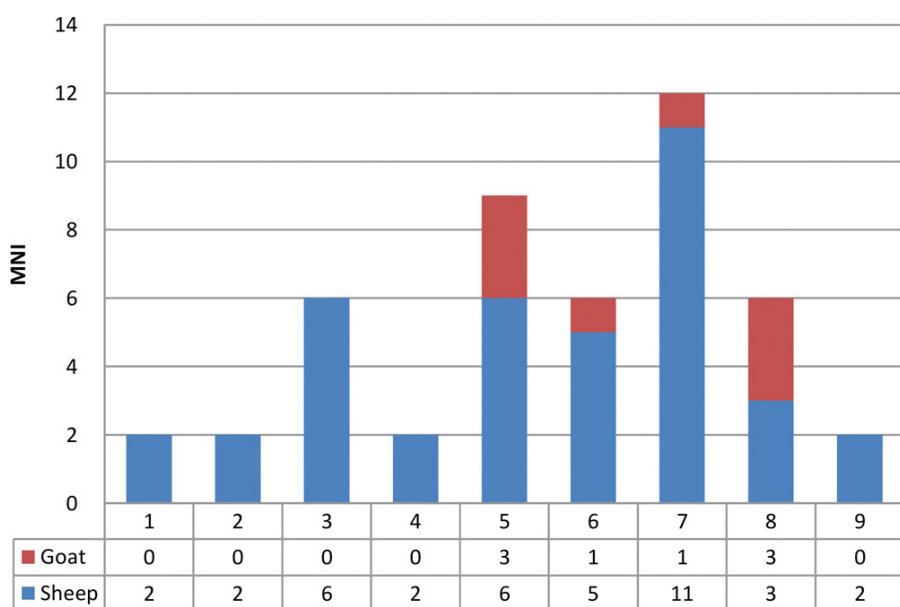


Fig. 13.4. Mortality profiles of sheep and goats based on Payne's (1973) eruption and wear stages.

Kill-off patterns of major domestic animals

Slaughtering patterns of domestic sheep and goats reflect the exploitation strategies of its primary and secondary products which determine the schedule of culling (Sherratt 1981; 1983). The reconstruction of sheep and goats kill-off profiles is based on the estimation of the survival age of individuals according to the dental ages and the sequence of epiphyseal fusion of postcranial elements presented by Silver (1969). In the present analysis sheep and goat fragments are grouped together for this purpose due to the low

number of fragments which provide dental or epiphyseal information. Deniz and Payne's mandibular teeth eruption and wear stages are used to classify both sheep and goat remains into age (Deniz & Payne 1982).

Fused and unfused bones are recorded following Redding (1984). The results are presented in [Figure 13.3](#). According to sheep and goat survival curves based on epiphyseal fusion in EBA levels, the inhabitants of the site did not concentrate on one specific exploitation strategy. Rather, they controlled the livestock to provide a variety of products. This trend is similar to a certain extent in each EBA level. Apparently more than 70% of the sheep/ goat individuals survived beyond their first year, except in EJ IIIa phase, when fewer animals (about 60%) in the sample reached 1 year of age. In EJ II, EJ IIIb and EJ IV phases 45–50% of the sheep and goats were slaughtered as subadult, while in EJ IIIa phase less than 30% survived beyond their second year of age. During EJ II and EJ IIIa phases less than 10% of the sheep/goat population lived beyond their fourth year, while in EJ IIIb and EJ IV phases about 23% of the herd reached the adult stage. This suggests a dependency on the herd to provide meat in the first place. In EJ IIIb and EJ IV phases the number of adult animals increased, which might have been employed in producing secondary products, like dairy products or wool/hair.

The evaluation of age distributions based on eruption and wear of mandibular teeth ([Fig. 13.4](#)) demonstrates an emphasis on animals which exceeded their optimal meat size at 2–4 years (Uerpmann 1973). It seems that goats were exploited to provide milk in the first place; its slaughter age ranges between 2 and 8 years old. The age estimation of goat mandibles suggests that they were culled due to the reduction of dairy products or the decrease of reproduction rates.

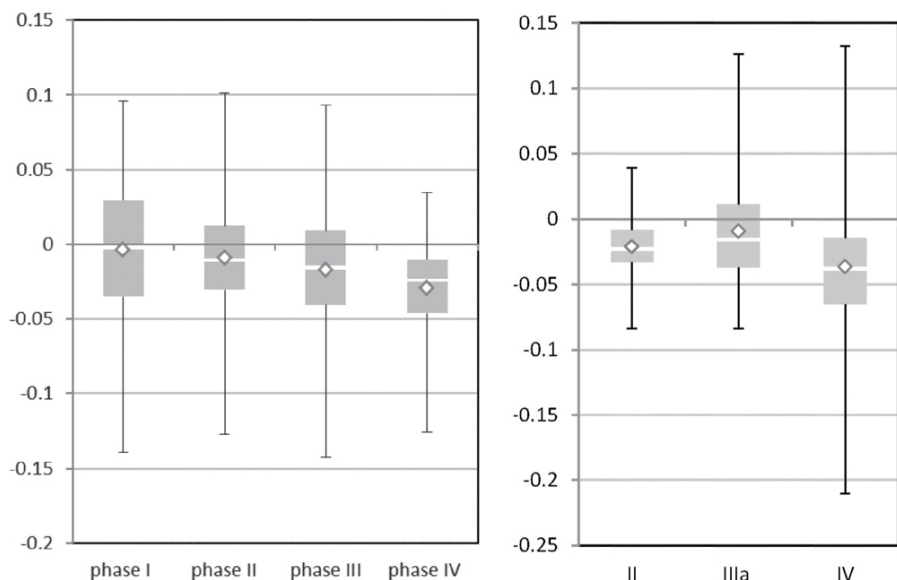


Fig. 13.5. LSI values of sheep measured elements including two sites at a. Tell Bderi and b. Tell Mozan. $\diamond$ = mean values

Sheep kill-off pattern during EBA period displays a different model of slaughtering. The slaughtering of young lambs under 6 months of age is postulated as a result of milk exploitation, while the high number of sheep between 6 months till the second year of age suggests the exploiting these animals to extract meat in the first place. Figure 13.4 demonstrates a notable peak in the number of sheep slaughtered between second and fourth years; according to Helmer (Helmer *et al.* 2007) the culling of sheep which belong to this age range is a result of focusing on milk exploitation.

Another prominent peak in the sheep kill-off pattern belongs to individuals in their fourth and sixth years, which were kept alive until adulthood to provide offspring and secondary products like milk and fleece. In conclusion it seems that different slaughtering strategies were combined at Bderi to maximise the products extracted from the domestic sheep and goat herd.

The sample of *Bos* mandibles is very small and could not provide a meaningful age profile. The survival rates according to the timing of long-bones fusion (Silver 1969) showed that approximately half of the documented population survived until the 1–2 years old age stage. In IIIb phase 20% of the long-bones belong to young individuals that did not reach their first year. The selection of the slaughtered cattle seems to be in favour of adult animals which should have been exploited for mixed use of meat, dairy, and traction. The sample of cattle jaws and

teeth was too small to provide meaningful results with regard to culling age.

Size of domestic species

Size index methods as introduced by Uerpmann (1979) and Meadow (1981; 1983) are used to evaluate the variations in sheep and goat body size within the different phases of the EBA period at Tell Bderi. The breadth and depth dimensions of bones of modern female and male *Capra aegagrus* and female *Ovis orientalis* documented by Uerpmann (1997) and Uerpmann and Uerpmann (1994) were used as standard. The results are shown in box and whiskers plot for both sheep and goats from EJ II level until EJ IV (Figs 13.5a, b and 13.6.a, b). It seems that the domestic sheep at Bderi went through a gradual decrease in size during the 800 years of occupation at the site. The median values of the measured individuals shift from 0.00 in EJ II phase to -0.02 at EJ IV the final stage of occupation at the site during the EBA period (Fig. 13.5a) . A corresponding change in the size of sheep is also witnessed at Tell Mozan. The LSI values of measured sheep elements from Levels II, IIIa, and IV at tell Mozan display a decrease in size (Fig. 13.5b). The use of LSI method to demonstrate the changes of size has several limitations (Meadow 1999; Zeder 2001); one of these limiting factors is sex and age distribution within the studied sample (Zeder 2001). its seems that during the last phase of EBA occupation IV there was an increase in the number of individuals smaller than the first quartile that could be interpreted as the increase of smaller female individuals, which resulted in the shift of median values. The changes in the size of sheep within the Khabur valley area might be related to several different factors, such as breeding preferences, or the shift in environmental conditions (Peters 1983, 53).

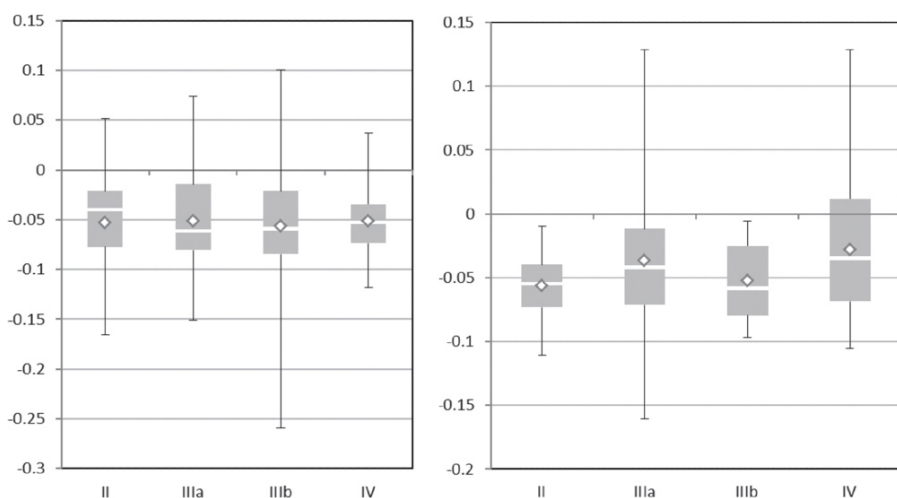


Fig. 13.6. LSI values of goats measured elements including two sites; a. Tell Bderi and b. Tell Mozan. $\diamond$ = mean values

The measurements of the goat bones included in the LSI analysis; display similar size indices during the different phases of occupation at the site, and did not show any significant change in size during the EBA (Fig. 13.6a). Goats indices from Tell Mozan show similar median values in EJ II and EJ IIIb, while the size increased in EJ IIIa and IV period (Fig. 13.6b). The box plot of goat size indices demonstrate that goats were not subject to the same factors which altered the distribution of size indices of sheep, which might indicates the keeping of more female sheep.

The number of measured cattle bones is not sufficient to calculate the size indices of cattle during the different phases of the EBA period.

Distal metacarpus measurements are used to compare the size of cattle individuals at Bderi to EBA and LBA cattle from other sites situated to north and south of Khabur valley (Fig. 13.7). Breadth versus depth plot of cattle's metacarpus measurements demonstrates that Bderi's cattle are close in size to the EBA period cattle from Tell Mozan (Doll n.d.) and Tell Sheikh Hamad (Becker 2008) which is situated further south in the Khabur valley and in a drier environment than Tell Bderi. The sample of Tell es-Sweyhat, located in the Middle Euphrates valley within the same rainfall zone of Tell Bderi, displayed smaller cattle individuals comparing with Khabur valley population (Weber 1997).

Figure 13.8 demonstrates the variation of first phalanx measurements of equids, based on greatest length versus smallest breadth measurements. It shows that equid elements from Tell Bderi included in the analysis are within the range of *Equus hemionus* ratios

from Tell Bayder. At the same time the size of Bderi's equids is similar to the majority of individuals present at other sites in al-Jazira, such as Tell Mozan and Tell Sheikh Hamad.

Element distribution of sheep and goat bones

All the skeletal elements are well represented at the different levels of EBA settlement. Sheep and goat remains from EJ II, EJ IIIa, and EJ IIIb levels are evaluated according to the location of their contexts at the site; either outdoor or indoor areas. The available skeletal elements are grouped by skeletal regions presented in [Figure 13.9](#). The number of limb-bones is the highest within the structure and street contexts, followed by skull remains. The underrepresentation of axial elements is the result of the difficulty in assigning vertebra and rib fragments to species level. When we added the proportion of medium-size mammal vertebrae – assuming that the majority of these vertebrae and ribs belong to sheep or goat individuals – to the total number of skeletal elements of sheep and goat group, the axial fragments shows a similar distribution to the proportion of head fragments ([Fig. 13.9](#)) Limb fragments are more abundant in outdoors contexts; that gives an indication to the use of the narrow lanes between the houses for discarding food refuse. Low meat weight elements like cranial and lower feet bones are present at different levels of EBA which suggests the slaughter of sheep and goat individuals at the site. Even when we regrouped the postcranial limb elements of sheep and goats ([Table 13.5](#)), a similar result can be observed; low meat weight elements represented by (metapodials and phalanges) scored a high frequency especially in EJ II as it formed more than 60% of the total skeletal elements. Accordingly the presence of both low and high meat elements in both indoor and outdoor areas reflects the proximity of the medium size meat resources to the inhabited areas at the site. At the same time, it indicates a lower degree of social complexity which should be attested by the selection of body parts elements depending on the organization of social strata of the inhabitants of the site (Zeder 1991).

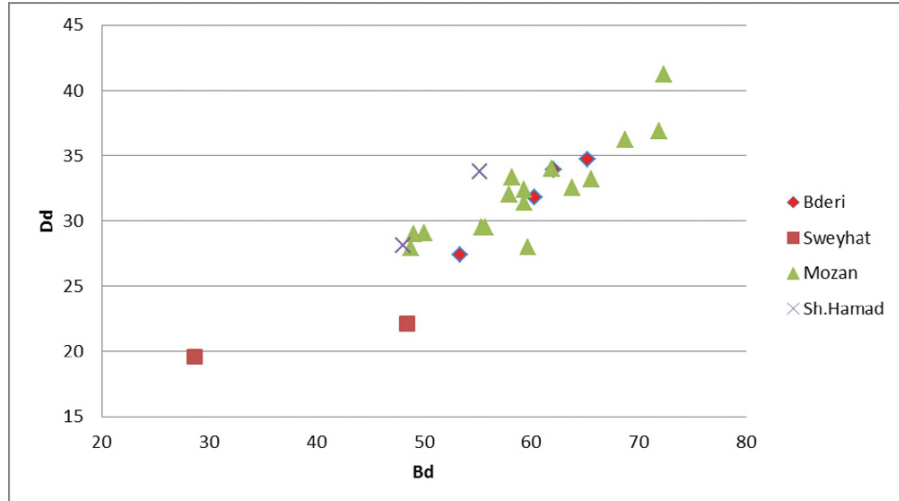
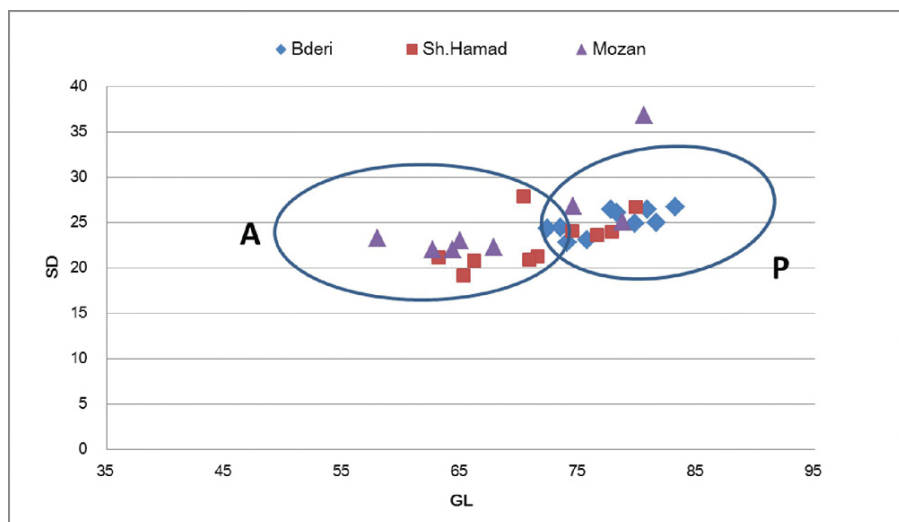


Fig. 13.7. Comparison of cattle at Tell Bderi and in the EBA based on distal metacarpus measurements.



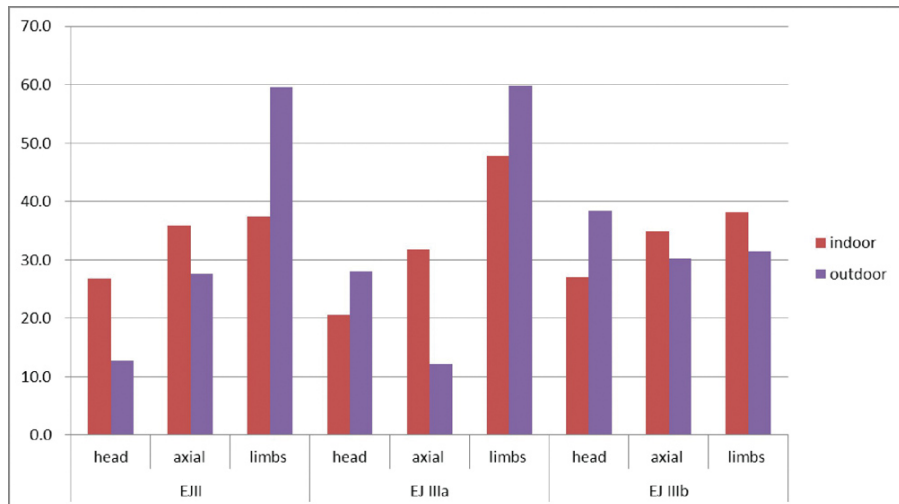


Fig. 13.9. Distribution of sheep and goat elements based on the percentage of NIS counts.

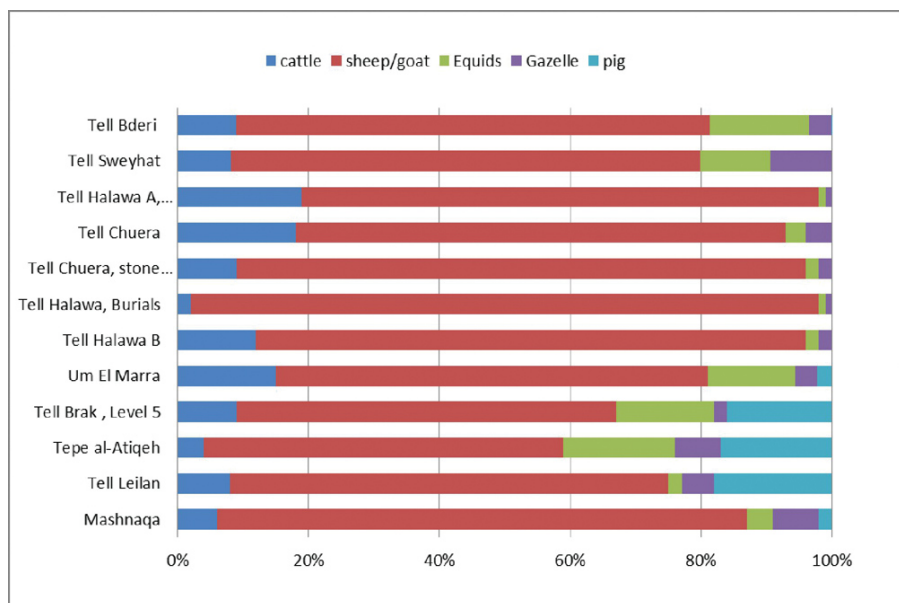


Fig. 13.10. Distribution of principal animal species at EBA sites in northern Syria.

Discussion and conclusion

According to the archaeological records, the EBA town at Tell Bderi was an important urban centre at least within the Middle Khabur valley. Most probably the town played an essential role in the wider region of northern Mesopotamia (Akkermans & Schwartz 2003, 218;

Zeder 1998a; Pfälzner 2001). The faunal analysis of the materials recovered from the four distinct levels of the EBA period at the site suggests a pattern of animal economy focusing on the intensive exploitation of sheep and goat herds which were raised in the surrounding steppe area. However, it can also not be excluded that the small ruminants were part of a larger system of herds pastured in the area further away from the agricultural fields (Hole 1999b). It seems that the inhabitants of the settlement adapted their subsistence strategies according to the environmental settings of the Khabur valley. Sheep and goat are the most suitable livestock to inhabit the arid steppe areas located in the southern part of the Khabur basin. At the same time the proximity of the settlement to banks of the Khabur River provided the moist conditions which facilitated the exploitation of cattle at the site.

Table 13.5 Distribution of sheep and goats limb elements percentages

<i>EJ II</i>	<i>Unidentified context</i>	<i>Rooms</i>	<i>Streets</i>
Shoulder	19	6	11
Lower fore limb	17	12	18
Haunch	33	36	0
Lower hind limb	7	17	7
Feet	24	29	64

<i>EJ IIIa</i>	<i>Unidentified context</i>	<i>Rooms</i>	<i>Streets</i>
Shoulder	31	28	43
Lower fore limb	10	10	6
Haunch	21	22	6
Lower hind limb	24	23	4
Feet	14	18	41

<i>EJ IIIb</i>	<i>Unidentified context</i>	<i>Rooms</i>	<i>Streets</i>
Shoulder	19	23	23
Lower fore limb	14	10	7
Haunch	21	19	26
Lower hind limb	14	14	18
Feet	32	34	26

<i>EJ IV</i>	<i>Unidentified context</i>	<i>Rooms</i>
Shoulder	24	21
Lower fore limb	12	21
Haunch	24	29
Lower hind limb	13	0
Feet	27	29

Wild animals also contributed to the economic structure of the

town. The hunted animals were mainly onager and gazelle. The nature of onager exploitation at the site, however, is not clear. Bones with low and high meat value were retrieved within a variety of contexts, indicating that onagers were brought back as whole animals. This might indicate that they inhabited areas in the proximity to town, or even that they might have been kept within the town wall.

Third millennium BC settlements in northern Mesopotamia and upper Euphrates regions displayed two distinct animal exploitation patterns (Fig. 13.10). The northern urban estates which are in areas receiving higher rain precipitations such as Tell Leilan and Tell Brak (Zeder 1994; 1998b; Emberling *et al.* 1999) depended on sheep/goat, apart from consuming of considerable number of cattle, pigs, and equids. Middle Euphrates and Khabur valley sites produced different animal species distribution ratios. The subsistence strategies adopted at these settlements focused on the intensive exploitation of sheep/goat herds, cattle had a minor role and pig was rarely documented. Wild fauna, such as gazelles and hemiones, formed a substantial portion of the animal species present at those sites, reaching similar proportions as some domestic animals such as cattle, and pigs.

This trend is also observed at Bderi and it could be a response to the environmental differences between the northern and southern areas, the socio-economical relations, which are the basic to the subsistence patterns at each site, also influenced the interaction within the adjusting towns. From that perspective the inhabitants of Tell Bderi employed their time in herding domestic animals to provide the main bulk of primary and secondary products. But still they exploited the wild resources in adjacent steppe areas, and possibly also the northern highlands, in order to supplement their economical resources with wild-game.

The last phase of occupation at the site displays changes in the proportion and the size of some of the domestic species. This implies a move towards more stable agro-pastoral society, evidenced by an increase of cattle, the decrease of hunted wild animals, and the intense exploitation of secondary products. These changes in the economic base of the community of Bderi could be considered as a response to the rise of Akkadian political power in northeastern Syria (Akkermans & Schwartz 2003; Mieroop 2006); which might have imposed the alternation of production and distribution processes of domestic animals. However, the gradual adaptation of new consumption patterns of animal resources also coincided with the climatic degradation (Rosen 2007; Ristvet n.d.; Weiss *et al.* 1993); Changes in stock-herding could therefore also be considered as a

response to the dryer and cooler conditions which should have affected the availability of wild resources, and thus imposed a more intense control on the domestic herds aiming to increase production (Zeder 1991).

The study of indoor and outdoor activities through body part distributions indicates the slaughtering of a considerable number of medium and large sized mammals within the settlement. It did not provide any clear evidence for specialisation indicated by particular distributions of skeletal elements. It seems that the population lived on resources which were acquired through local economical system. The archaeological records from Bderi suggest a special role of the settlement within the complex of sites that appeared in the Khabur valley during the beginning of the 3rd millennium. It appears to have been the most densely populated fortified town in the southern Khabur valley (Pfälzner & Shaath 1986; Pfälzner 1990a; Pfälzner & Mahmoud 1986). The faunal evidence, however, suggests that the settlement was more a self-providing agro-pastoral town, than a centre controlling animal production and distribution within a larger part of the valley.

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Note

- 1 The excavators attributed this bone tool to EBA levels; however, this object is not connected to any stratigraphically identified layers at the site.

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14. Exploitation of fauna at Ras Shamra: case study of the ‘Maison aux Albâtres’, Late Bronze Age, northern Levant

Jwana Chahoud & Emmanuelle Vila

This paper presents an analysis of the faunal remains from the Late Bronze Age building ‘Maison aux Albâtres’ (MA). MA is one of the excavated areas of Ras Shamra/Ugarit, a Late Bronze Age kingdom located on the Syrian coast. The analysis of animal bone remains from this site are intended to provide an understanding of the economic basis of the inhabitants of Ras Shamra. This contribution offers observations on herd management and meat consumption in order to gain insight concerning subsistence preferences and sociopolitical influence on the economy and animal exploitation of northern Levantine societies during the Late Bronze Age (LBA). The subsistence economy was based on livestock husbandry focused on sheep, goats and cattle and on a wide exploitation of the surrounding environment, including hunting wild mammals and birds as well as fishing. The subsistence patterns of the MA building residents appear to reflect the practices of the society of Ugarit.

Keywords Ugarit, Levant, Late Bronze Age, Husbandry, Hunting, Fishing, Burial offering

Introduction

The archaeofaunal assemblage analysed for this paper comes from one of the private residences, the so-called ‘Maison aux Albâtres’, in the city of Ugarit on the Syrian coast (Fig. 14.1). This region is characterised by a Mediterranean climate and landscape - a warm, dry

summer and a moderate, humid winter, with a diversity of modern vegetation composed mainly of Mediterranean woodland mixed with areas of cereals. Analyses of animal bone remains from the city are still ongoing, linked to the current excavations of the Late Bronze Age levels of Ras Shamra/Ugarit. This article presents an initial study of one building, excavated in the sixties by Claude Schaeffer (1969), and then in the seventies by Elisabeth and Jacques Lagarce (1973). These Late Bronze Age (LBA) levels, 1600-1200 BC, have revealed a complete organized governmental compound consisting of a palace and other sub-palaces and administrative and/or religious buildings (Yon 1982). Archaeological evidence points to the existence of a complex and privileged society in this LBA city.

Site and material

The osteological material was recovered from the 'Maison aux Albâtres' (MA) located to the northeast of the royal palace of Ras-Shamra/Ugarit (Fig. 14.2). This private residence is divided into two levels linked by a small staircase and is characterised by double floors, four entries, a courtyard AV, an outdoor kitchen AB and about 14 rooms (Fig. 14.3). The rooms were described by the archaeologist as some for industrial usage, others for public or domestic activities (Lagarce *et al.* 1973).

The archaeological remains found within reveal that the owner probably occupied a high position, 'an Egyptian diplomat at the court of Ugarit', and had a particular relation with Egypt (Lagarce *et al.* 1973). The study of the figurines found in this residence attributes the occupation of the building to the time of the 19th Egyptian dynasty. According to Lagarce *et al.* (1973) and Schaeffer (1969), three levels were detected: Late Ugarit 1 (1600–1450 BC), Late Ugarit 2 (1450–1365 BC) and Late Ugarit 3 (1360–1200 BC). According to recent studies in Ugarit and Ras Ibn Hani, Jacques and Elisabeth Lagarce (2008) consider that the remains excavated in the MA are dated to the final level of the Late Bronze Age (1300–1200 BC). The material found on the only excavated level is ascribed to a third phase of occupation of MA except the material from the burial BDT; soundings were conducted on the first two levels and have yielded also some remains. During this third phase, the residence was divided into two isolated parts for the lower floor and a private sanctuary related to funeral rite was identified in room BD above a burial BDT (Lagarce & Lagarce 2008). This latter phase of occupation was dated between a first destruction by earthquake in the 13th century and a second brutal destruction in the 12th century when the inhabitants were forced to

abandon their residence. The devastated walls of the building, the traces of fire, the black and carbonised layer and the spatial distribution of the finds (for example, concentration of arrowheads in the west) reveal a probable attack upon the building from the west and destruction by fire. It is an argument which supports the assumption that the end of the kingdom of Ugarit was caused by an invasion and not by a natural disaster (Lagarce *et al.* 1973).

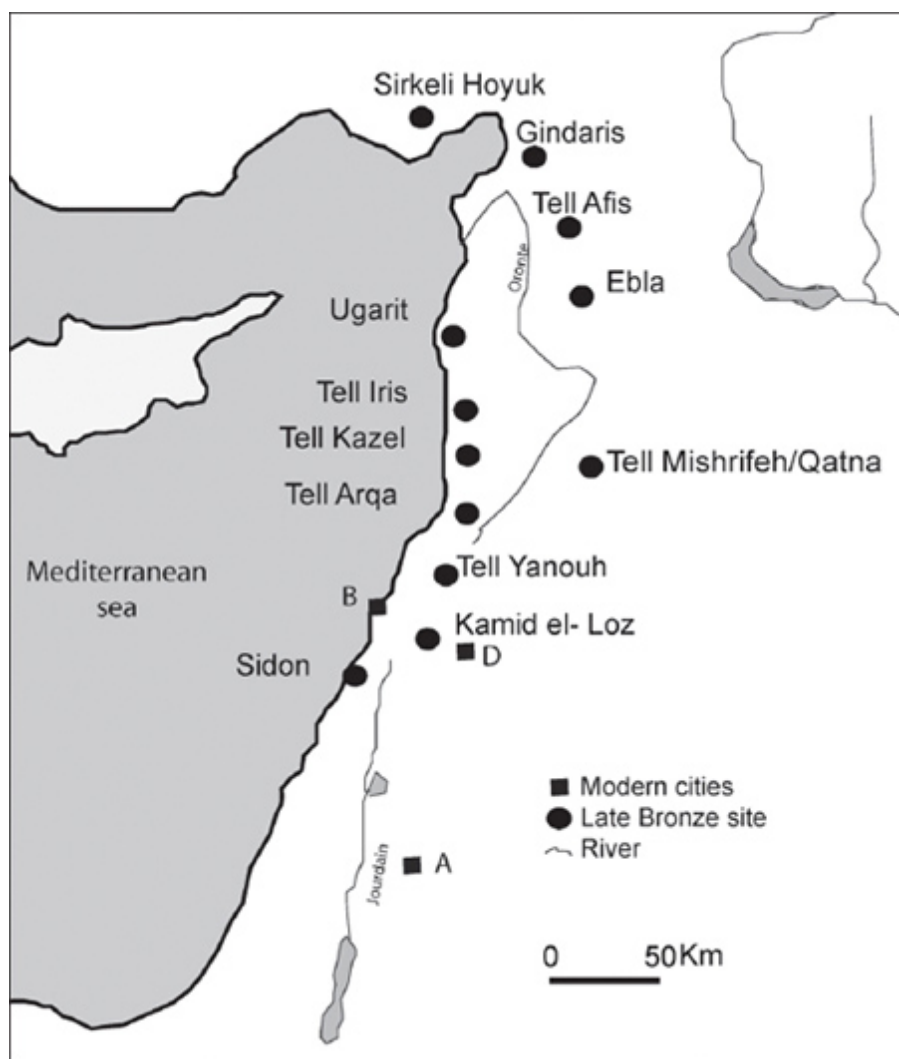


Fig. 14.1. Location of Ras Shamra/Ugarit.

About 2481 bone remains were recovered from all over the building, being abundant in rooms BD, H and I and rare in others (Table 14.1). The highest frequency, 60% of the bone remains, was

found in a pit described as a soakaway/sump in the lower floor room AM. The animal bones were hand-collected from the bottom of this constructed pit that was used in the same period as the occupation of the building and was filled with Mycenaean figurines and pots similar to those found on the floors of LBA levels in the MA. Of the total remains, 21% were collected from the burial BDT excavated beneath the room BD. The material from the latter was sieved and is presented separately in this study.

A relevant percentage of weathering marks was recorded on the material collected from the sump AM; 612 out of 1495 of the remains (42%) show important bone surface exfoliations suggesting an alternate climate variation. A small degree of chemical erosion was found on the bones, evidence of streaming water in the sump.

Methods

The animal bone remains were examined and recorded according to their stratigraphic location. Zooarchaeological and taphonomic analyses were systematically carried out on every fragment. The identified fragment was recorded by describing the specific skeleton part, its side, the fraction of the bone and its surface modifications (i.e., butchering cut, weathering marks ...). The number of identified specimens (NISP) was used as a basic measure of taxonomic diversity. The minimum number of skeletal elements (MNE) was used to record the body part distribution based on the minimum number of individuals (MNI) in order to reduce the effect of potentially variable fragmentation between taxa (Poplin 1977; Vigne 1988). The material scattered in different rooms was grouped together and analyzed as one assemblage, but each room was considered as an entity apart so that the total MNI represented the sum of the MNI deduced from each room. For that reason the maximum MNE of a group does not correspond to the total MNI, except in burial BDT, because no grouping together was carried out.

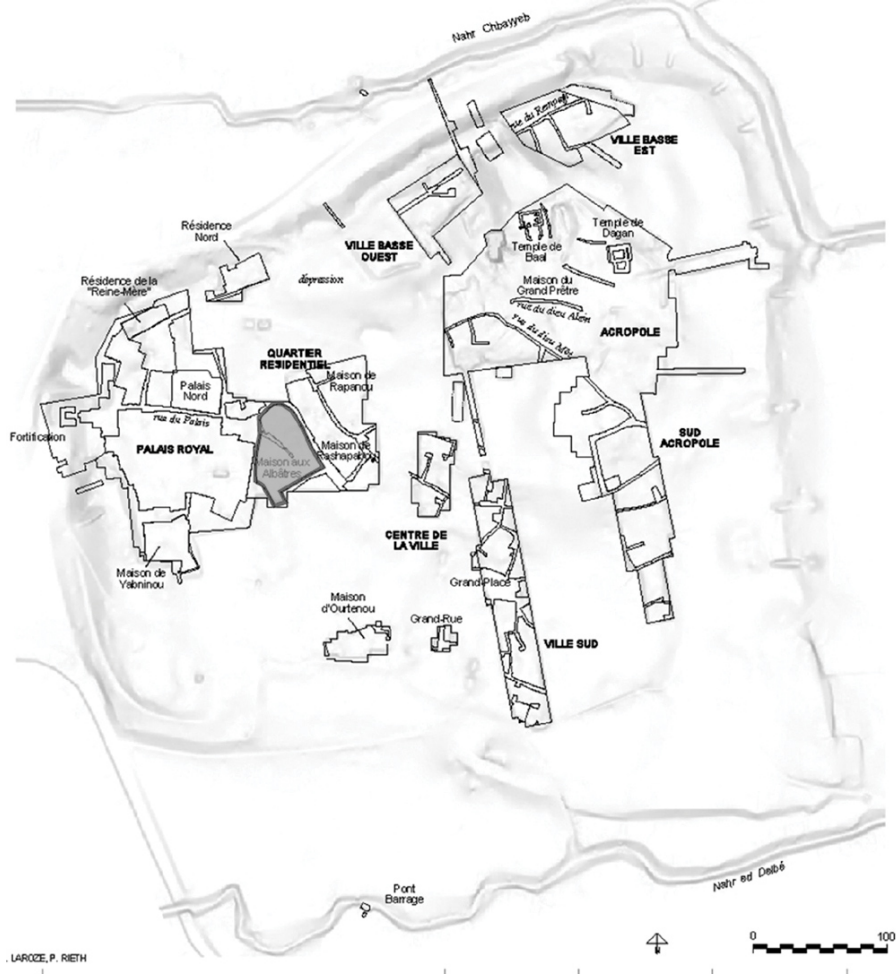


Fig. 14.2. Location of the 'Maison aux Albâtres' (highlighted) inside the city of Ugarit. (Lagarce et al. 1973).

Sheep and goat determination was based on multiple detailed studies about the discrimination between these two close species; for bones, we referred to Boessneck (1969), Helmer and Rocheteau (1994), Fernandez (2001) and Prummel (1986). As for teeth, distinction criteria of Balasse and Ambrose (2005), Halstead *et al.* (2002) and Helmer (2000a) were applied on the material of this study.

Table 14.1. Distribution of bone remains in the MA rooms

<i>Room</i>	<i>NISP</i>	<i>WISP</i> (g)	<i>%NISP</i>	<i>%WISP</i>
AM (sump)	1495	10354	60.26	66.04
BDT (burial)	531	1785	21.40	11.38
BD	232	1602	9.35	10.22
X	73	650	2.94	4.15
H	52	424	2.10	2.70
I	36	223	1.45	1.42
AF	18	208	0.73	1.33
AB	11	217	0.44	1.38
Varia (various room)	10	50	0.40	0.32
AZ	4	15	0.16	0.10
BB	4	19	0.16	0.12
AW	3	22	0.12	0.14
U.P	3	42	0.12	0.27
AV	2	26	0.08	0.17
BC	2	29	0.08	0.18
AR	1	4	0.04	0.03
AW/AB	1	5	0.04	0.03
J et K	1	1	0.04	0.01
W	1	1	0.04	0.01
AC	1	2	0.04	0.01
<i>Total</i>	<i>2481</i>	<i>15679</i>	<i>100</i>	<i>100</i>

Table 14.2. Species abundance of the MA fauna (No. and weight of identified specimens and Minimum Number of Individuals)

<i>Taxa</i>	<i>NISP</i>	<i>WISP(g)</i>	<i>MNI</i>	<i>%NISP</i>	<i>%WISP</i>
Sheep/ Goats	1036	4893	64	78.0	46.5
Sheep	149	1377	17		
Goat	142	1424	18		
Cattle	278	5934	19	20.9	51.7
Dog	1	13	8	0.1	0.1
Horse/Ass	2	9	1	0.2	0.1
<i>Domestic animals</i>	<i>1317</i>	<i>13,650</i>	<i>127</i>	<i>99.1</i>	
Wild boar/pig	1	5	1	0.1	0.1
Deer/fallow deer	9	129	5	0.7	1.2
Bear	2	36	1	0.2	0.3
<i>Wild animal</i>	<i>12</i>	<i>170</i>	<i>7</i>	<i>0.9</i>	
Rodent	0	0	0	0.0	0.0
<i>Total identified mammals</i>	<i>1329</i>	<i>12,260</i>	<i>109</i>	<i>100.0</i>	<i>100.0</i>
Small ruminants	239	815			
Large ruminants	18	138			
Small mammals	187	86			
Large mammals	73	299			
<i>Total unidentified</i>	<i>517</i>	<i>1338</i>			
<i>Total Mammals</i>	<i>1846</i>	<i>13,598</i>	<i>109</i>	<i>94.7</i>	<i>97.9</i>
Bird	7	14	6	0.4	0.1
Tortoise	39	115	2	2.0	0.8
Fish	35	87	15	1.8	0.6
Shellfish	0	0	0	0.0	0.0
Mollusca	23	80	23	1.2	0.6
<i>Total</i>	<i>1950</i>	<i>13,894</i>	<i>155</i>	<i>100.0</i>	<i>100.0</i>

The age-at-death for caprine was analysed on the basis of tooth eruption and wear sequences. The culling profile was produced according to Helmer (1995; 2000a; 2000b), based on the number of teeth (ND), the method proposed by Ducos (1968). Age structure was also analysed by examining the stage of epiphyseal fusion of certain skeletal elements, according to Silver (1969) and Vila (1998). We followed the measurement guide of von den Driess (1976) and Vigne (1988) for the postcranial elements.

Results

The faunal assemblage hand-collected from the various rooms consisted of 1950 recorded bones; only 1433 were identified, for a weight of 12,556g (Table 14.2). The 21% found in burial BDT corresponds to 513 remains, weighing 1785g (Table 14.3). Mammals dominate the spectrum with a majority of domestic animals (99%) especially goats, sheep and cattle. Other taxa such as donkey (three fragments of teeth; *Equus* cf. *asinus*), dog and rodent were also detected but in fewer frequencies. In term of bone weight, cattle represent the highest frequency (52%) followed by caprine. The rare wild species are represented mostly by fallow deer. Very few remains of wild boar, bear and other carnivores are present in this assemblage. The other remains include Greek tortoise, birds (Hollom *et al.* 1988) such as ducks (*Anas* sp.), geese (*Anser* sp.) and pigeons (*Columba* cf. *palumbus*), and shells, shellfish and a diversity of fish.

Table 14.3. Species abundance in burial BDT

<i>Taxa</i>	<i>NISP</i>	<i>WISP(g)</i>	<i>MNI</i>	<i>%NISP</i>	<i>%WISP</i>
Sheep/ Goats	281	804	9	88.1	64.7
Sheep	27	215	3		
Goat	17	59	2		
Cattle	31	402	3	9.7	32.4
Dog	3	2	2	0.9	0.2
Horse/Ass	0	0	0	0.0	0.0
<i>Domestic animals</i>	<i>359</i>	<i>1482</i>	<i>19</i>	<i>112.5</i>	<i>119.3</i>
Wild boar/pig	1	11	1	0.3	0.9
Deer/fallow deer	1	21	1	0.3	1.7
Bear	1	2	1	0.3	0.2
<i>Wild animal</i>	<i>3</i>	<i>34</i>	<i>3</i>	<i>0.9</i>	<i>2.7</i>
Rodent	1	0	1	0.3	0.0
<i>Total identified mammals</i>	<i>363</i>	<i>1516</i>	<i>19</i>	<i>113.8</i>	<i>122.1</i>
Small ruminants	51	189			
Large ruminants	8	71			
Small mammals	86	132			
Large mammals	10	76			
<i>Total unidentified</i>	<i>155</i>	<i>468</i>			
<i>Total mammals</i>	<i>518</i>	<i>1984</i>	<i>19</i>	<i>97.6</i>	<i>111.1</i>
Bird	5	1	2	0.9	0.1
Tortoise	0	0	0	0.0	0.0
Fish	21	20	8	4.0	1.1
Shellfish	1	4	1	0.2	0.2
Mollusca	30	50	15	5.6	2.8
<i>Total</i>	<i>575</i>	<i>2059</i>	<i>45</i>	<i>108.3</i>	<i>115.4</i>

Table 14.4. Distribution of MNE

	Sheep		Goats		Sheep/ Goats			Cattle		
	NISP	MNE	NISP	MNE	NISP	MNE	% MNE	NISP	MNE	% MNE
Phalanges	25	2	25	2	59	2	3.13	16	5	26.32
Metapodium	25	6	16	5	93	33	51.56	23	5	26.32
Calcaneus	5	2	8	3	17	7	10.94	2	1	5.26
Astragalus	8	5	3	1	18	7	10.94	14	10	52.63
Tibia	8	4	7	3	92	27	42.19	14	11	57.89
Femur	11	4	6	3	77	33	51.56	20	12	63.16
Pelvis	3	3	0	0	33	9	14.06	11	9	47.37
Carpal/tarsal	4	3	0	0	9	3	4.69	7	4	21.05
Ulna	7	3	8	2	19	7	10.94	6	5	26.32
Radius	14	4	8	3	48	22	34.38	4	4	21.05
Humerus	9	3	6	2	61	17	26.56	7	3	15.79
Scapula	6	3	13	5	47	17	26.56	10	8	42.11
Vertebrae	4	1	2	1	145	2	3.13	47	5	26.32
Ribs	0	0	0	0	142	2	3.13	45	6	31.58
Mandible	7	3	9	2	76	20	31.25	20	7	36.84
Skull	13	3	31	4	240	8	12.50	32	5	26.32
Shaft	0		0		28		0.00			
Total	149	17	142	18	1204	64	100	278	19	100

Sheep and goats

The caprine were the most frequent domestic animals consumed on the site, 53% of all the remains and 78% of the determined mammals. A minimum of 64 individuals were identified as sheep (*Ovis aries*) and goats (*Capra hircus*). The ratio of sheep to goat is 1:1. Goats outnumber sheep in terms of MNI (Table 14.4), 18 to 17 and in weight 1424g to 1377g.

No preference could be revealed in the body part distribution for sheep or for goats. All bone elements were found on LBA levels of the MA (Fig. 14.4). The minimum number of elements seems to indicate a slight preference for hind limbs and forelimbs, the parts rich in meat. However, metapodia and cranial remains (mostly teeth, mandibles, frontal bones and horn cores) also dominate the spectrum; these parts are robust and thus the best preserved portions of the skeleton. Foot bones (phalanges) and trunks (ribs and spine) are under-represented for all sheep and goats. In general phalanges belong to butchering waste or could be related to exploitation of the skins, but could also be used for culinary purposes.

Age profiles based on dental wear of the caprine teeth grouped together, according to Helmer (2000b) reveal a primary milk and fleece exploitation and a secondary meat consumption (Table 14.5). The caprine mixed profile reveals the slaughter of mature animals (Fig. 14.5). On separated sheep and goats age profiles, a high frequency of slaughtered 2-to-6-year-old goats suggest that they were culled for ‘ante-mortem (lifetime) products’ (Helmer & Vigne 2007), milk (type B) and fleeces.

On the other hand, the sheep culling profile shows high frequencies of individuals between 2 and 6 years old and older, evidence for consumption of animals produced from a management focused on ‘final products’ (Helmer & Vigne 2007): meat (type B) but also wool

exploitation. According to Helmer and Vigne (2007) and Helmer (2000b) the exploitation of fleeces was always found linked to the exploitation of meat in general; this would be the case for the culling profile illustrated for MA (Fig. 14.5).

The presence of fused postcranial bones confirms the higher frequency of sub-adult and adult goats and sheep slaughtered in MA. But young animals with unfused long bones (at least three individuals under 2 years old, out of 64) are also present (cf. Table 14.6).

Cut marks are not frequent on goat and sheep remains, being present on only 10% of the total remains. Higher frequencies of cut marks were recorded on proximal and distal joint of limbs and feet. This is related to butchering practices focused on the disarticulation of limbs. Cut marks are also recorded on limb bone shafts, which indicates that meat was cut from the bone (cf. Table 14.7). There are large numbers of fragmented bones and fracture of fresh bones is also frequent (175 NISP; 13% of total NISP).

Traces of burning on the bones are uncommon on the caprine remains (6% of total NISP). A low intensity of combustion is most frequently indicated on the material recovered from the MA. Burn marks are particularly present on fragmented bones (60% of a total of 78 burned fragments). Burn marks were found on all bone elements, therefore any indication of cooking practices or carcass preparation is not clear. The low degree of burning is normally representative of roasting, rather than immersion in flames. Burned bones may reflect cooking activities and culinary practices but they may also be the result of proximity to hearths and accidental burning. It should be noted that the fire that destroyed the building produced ashy layers that may have left marks on the bones.



Fig. 14.3. Plan of 'Maison aux Albâtres' MA (Lagarce et al. 1973, 6).

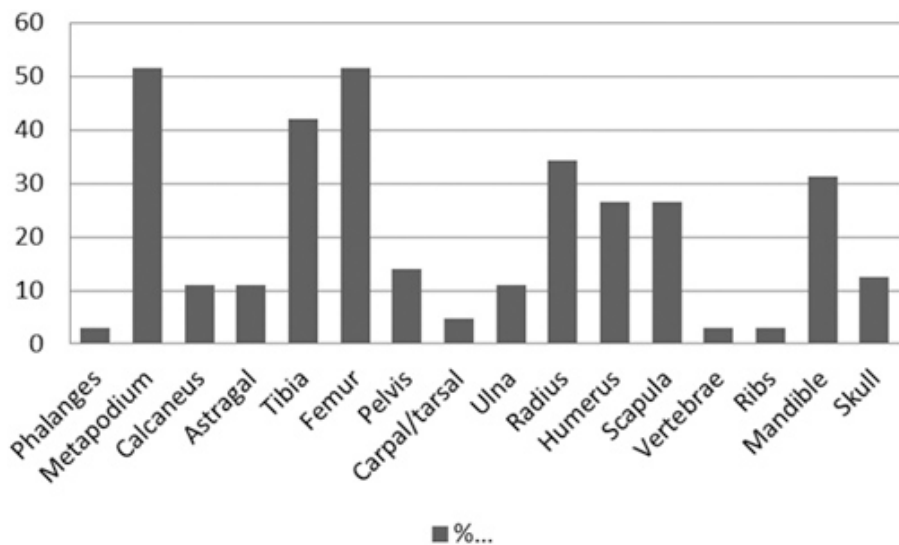


Fig. 14.4. Frequency of body part distribution of sheep and goats in minimal number (NISP: 1036, MNI: 64, cf. [Table 14.4](#)).

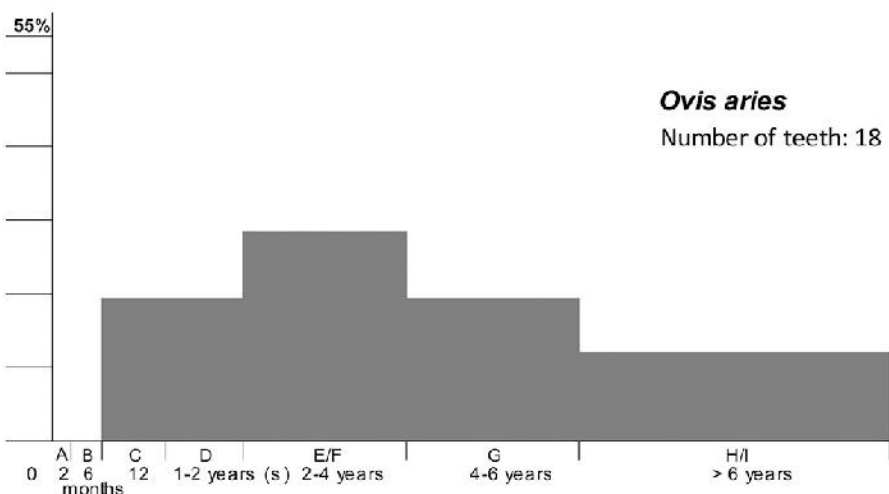
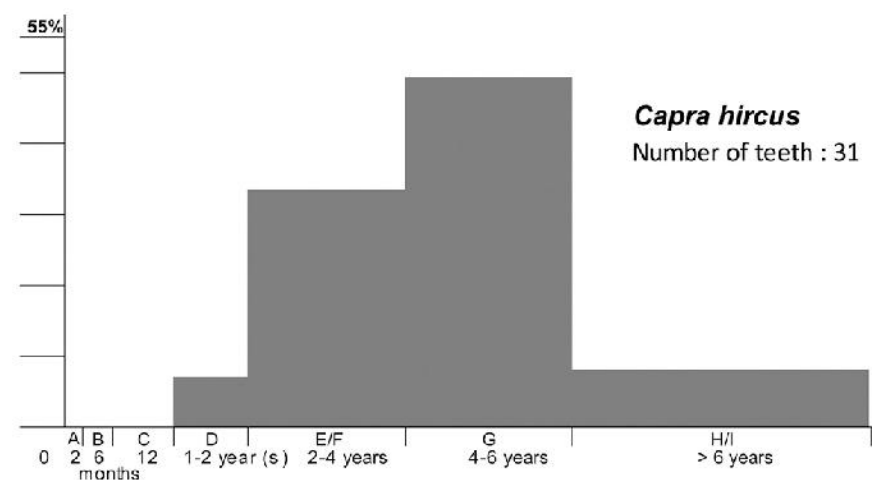


Fig. 14.5. Culling profiles of sheep and goats (cf. Table 14.5).

Table 14.5. Distribution of age-at-death for sheep and goats

Culling profiles on lower teeth								
<i>Capra hircus</i>								
Age group	A	B	C	D	E/F	G	H/I	Total
Age	0-2 months	2-6 months	6-12 months	1-2 year	2-4 years	4-6 years	>6 years	
N. of teeth	0	0	0	1.0	10.0	15.0	5	31.0
correct.	0	0	0	1.0	5.0	7.5	1	14.8
%	0	0.0	0.0	6.8	33.9	50.8	8.5	100.0
MNI	0	0	0.0	1.0	4	3	2	10.0
correct.	0	0	0	1.0	2.0	1.5	1	5.0
%	0	0.0	0.0	20.0	40.0	30.0	10.0	100.0
Culling profiles on lower teeth								
<i>Ovis aries</i>								
Age group	A	B	C	D	E/F	G	H/I	Total
Age	0-2 months	2-6 months	6-12 months	1-2 year	2-4 years	4-6 years	>6 years	
N. of teeth	0.0	0.0	1.0	2.0	6.0	4.0	5.0	18.0
correct.	0.0	0.0	2.0	2.0	3.0	2.0	1.3	10.3
%	0.0	0.0	19.5	19.5	29.3	19.5	12.2	100.0
MNI	0.0	0.0	1.0	1.0	2.0	2.0	2.0	8.0
correct.	0.0	0.0	2.0	1.0	1.0	1.0	0.5	5.5
%	0.0	0.0	36.4	18.2	18.2	18.2	9.1	100.0
Culling pattern of sheep and goats on upper and lower teeth								
<i>Caprine</i>								
Age group	A	B	C	D	E/F	G	H/I	Total
Age	0-2 months	2-6 months	6-12 months	1-2 year	2-4 years	4-6 years	>6 years	
N. of teeth	0.0	0.0	2.0	6.0	29.0		22.0	89.0
correct.	0.0	0.0	4.0	6.0	14.5	15.0	5.5	45.0
%	0.0	0.0	8.9	13.3	32.2	33.3	12.2	100.0
MNI	0.0	0.0	1.0	2.0	6.0	5.0	5.0	19.0
correct.	0.0	0.0	2.0	2.0	3.0	2.5	1.3	10.8
%	0.0	0.0	18.6	18.6	27.9	23.3	11.6	100.0

Pathological abnormality was recorded on three caprine remains: exostosis of metacarpal joints and phalanges. Dental abnormalities were found also on mandibles with abscess as well as on teeth with advanced stages of wear and very pointed and projecting molars. These deformations could be related to a malnutrition problems and/or a type of vegetation rich in abrasive materials and to advanced age (Etier-Lafon 1997, 75).

The body size index of the caprines was calculated based on the measurement of the length of bones such as the radius, metapodium and astragalus, and using the multiplying factor suggested by Teichert, quoted in von den Driesch and Boessneck (1974, 339). The average size of the sheep is estimated to be 71cm with a maximum range of 78cm for males and 64cm for females. The size of the goats varies between 73cm and 57cm, the average size being 61cm.

In the burial BDT, goats and sheep are represented by nine individuals with a MNI of three sheep and two goats. All body parts were recorded except hind limbs for goats, with a good frequency of forelimbs for sheep. According to the postcranial fused and unfused bones, four caprines appear to have been slaughtered before 2 years of age.

Cattle

Domestic cattle (*Bos taurus*) provided most of the meat in the MA in terms of bone weight, 51% of the total weight of identified mammals (e.g. 5934g). Cattle bone remains are mainly composed of hind limbs, rich in meat (Fig. 14.6). However, all bone elements are present in this assemblage and astragali appear to be very frequent (cf. Table 14.4).

According to the fused postcranial bones (cf. Table 14.6) and to the few teeth, the age-at-death of the 19 MNI of cattle in the MA varies: one calf (age <6 months), six individuals at least less than 2 years old, nine others older than 4 years and three 6–9 years old.

Cut marks were present on 50 cattle bones out of 278 (18%) especially on the extremities of limb bones. These incisions are related to the carcass processing and can indicate a practice of disarticulation of bones at the joint. Fragmentation and fractures on fresh bone were common (14%; 40 over 278 NISP) and were caused by chopper strokes. Marks from worked artefacts were found on one ox metacarpus (cf. Table 14.7).

An ox astragalus was found with a hole pierced at the distal end of the bone, which could suggest a special use, still unknown to us. This type of worked bone was recorded at Ras Shamra/Ugarit in the Royal Palace by Schaeffer (1962, 103–105), having a hole filled with lead, and used according to the interpretation of the author as a loom weight.

Table 14.6. Distribution of fused and unfused bones

<i>Age group</i>	<i>Sheep/Goats</i>	<i>Unfused</i>	<i>Fusing</i>	<i>Fused</i>
3–12 months	humerus distal	4	2	8
	radius proximal		1	25
	scapula distal	5		11
	pelvis	1		15
12–16 months	phalanges	2		30
16–28 months	tibia distal	2	2	11
	metacarpus distal	3		12
28–36 month	metatarsus distal	1		9
	calcaneus	5	2	4
	femur proximal	5	4	4
36–48 months	femur distal	8	3	8
	radius distal	7		5
	tibia proximal	9	3	
	humerus proximal	2	5	2
	ulna proximal	7		2

<i>Age group</i>	<i>Cattle</i>	<i>Unfused</i>	<i>Fusing</i>	<i>Fused</i>
6– 18 months	humerus distal		3	2
	radius proximal		1	1
	scapula distal	3		3
	pelvis	3		4
	phalanges			12
18–36 months	metapodium	2		9
	tibia distal	1	1	2
36–48 months	femur proximal	4		
	femur distal	1		3
	radius dist			2
	tibia proximal	2	1	1
	humerus proximal		1	
	ulna proximal			
	calcaneus			2

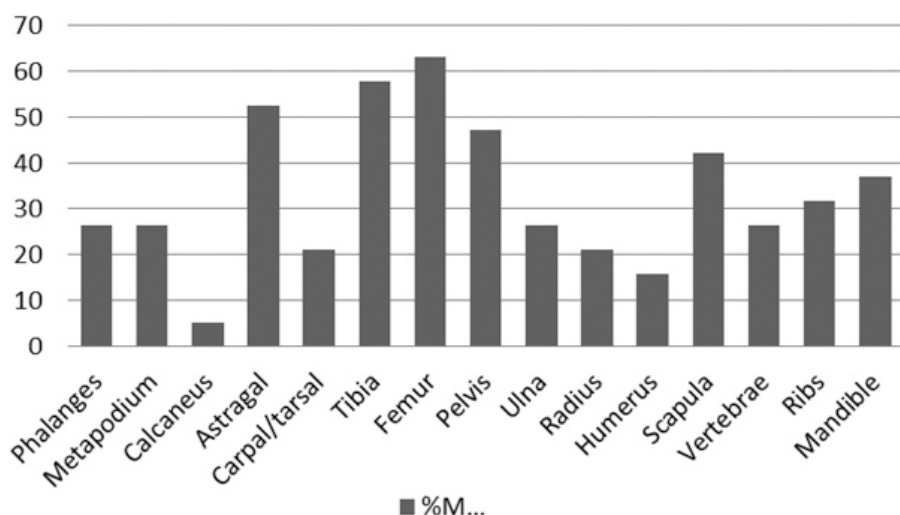


Fig. 14.6. Frequency of MNE of cattle (MNI: 19, NISP: 278).

Traction and labour can cause abnormal lesions and leave marks on cattle bones (Johannsen 2002). Two kinds of pathology were recorded on eight foot bones of cattle; three metacarpials present a distal posterior concavity, a 'palmar depression', and exostosis on the distal joint, 'lipping' (Bartosiewicz *et al.* 1997). Three phalanges present anomalies such as exostosis and lipping on the proximal edge of the bone. These remains presenting pathologies come from two draught oxen that had suffered from traction and/or labour. The 'palmar depression' is a developed stage of the pathological deformation; it is always in combination with other types of pathology like lipping or exostosis (Bartosiewicz *et al.* 1997).

In burial BDT, only three individuals were recorded with 31 NISP for 402g. All body parts were found except hind limbs. One individual less than 2 years of age, with unfused bones, was recorded in BDT, the other two being older.

Table 14.7. Distribution of cut marks on sheep/goats and cattle

Cut marks location	Shaft		Proximal/Distal end	
	Caprine	Cattle	Caprine	Cattle
Phalanges			6	
Metatarsus	3		1	3
Astragalus			4	3
Metacarpus	5	1	3	1
Tibia	8		7	5
Femur	3	1	5	1
Pelvis			2	1
Carpal/tarsal			1	1
Ulna			5	1
Radius	2	1	14	1
Humerus	1	1	9	1
Scapula			4	1
Vertebrae			11	10
Rib			4	8
Mandible			2	
Maxilla				1
Skull	2			4
Horn			4	
Total= 106	24	4	82	42

Deer

Ten remains (6 MNI) out of a total of 2490 were identified to be from the deer family. The differentiation between deer (*Cervus elaphus*) and fallow deer (*Dama mesopotamica* or *Dama dama*) is difficult due to their similar morphology (Di Stefano 1996). In Syria, the fallow deer is the most frequent representative of the deer family on the archaeological sites (Uerpmann 1987). The Mesopotamian fallow deer is similar in size to the deer because it is larger than the European species (*Dama dama*).

Unlike the body part distribution of the domestic animals, the remains of deer were less representative probably because of their smaller number. Forelimbs (1 scapula, 2 humerus and 1 ulna) and foot elements (2 astragali and 2 phalanges), particularly astragali and one antler, were the only recorded body parts in the assemblage. Cut marks were also recorded on the deer remains, especially on forelimb bones, suggesting a butchering practice of disarticulation and cutting of meat.

Two fallow deer astragali present strongly worn faces (one was found in the burial BDT). The use of such objects is unknown. The theory of the use of ankle bones in the production of pottery for smoothing the surfaces (Vila 2008a) is not completely adequate here.

Similar worn astragali were found in the assemblages of other excavated areas of Ras Shamra/Ugarit in various buildings and periods (Poulain 1978; Desse 1982; Vila 2008a).

Wild boar/pig

Two large size bone remains (phalanx and metatarsus) of Suidae were found in this assemblage and were identified to wild boar (*Sus scrofa*).

Carnivores

Seven remains of carnivores were identified. Dog (*Canis familiaris*) is the main species represented with one mandible and four limb fragments. The presence of the brown bear (*Ursus arctos*) is attested also in the fauna of MA by two phalanges and one upper canine.

Fish

Fifty-six fish remains, a sample that was small probably due to the lack of sieving, were recorded in the assemblage. Only 21 fragments were identifiable, found to be mostly parts of vertebrae and some skull fragments, after comparison with the reference collection of modern fish skeletons housed at the National Museum of Natural History (Paris)¹ and at the Royal Institute of Natural Sciences (Brussels).²

These fish remains reveal wide local, maritime and freshwater exploitation. The most frequently represented open sea, coastal and freshwater species are:

- marine fish: groupers (Standard length (SL) 50–60cm, 4 NISP) and carangids (SL: 50–60cm). Sea bream, sciaenidae (SL: 50–60cm, 2 NISP), as well as sharks.
- freshwater fish: Nile perch (SL: 40–50cm, 4 NISP; SL: 70–80cm, 5 NISP) and catfish.

In the burial BDT, sciaenidae (SL: 50–60 cm and 80–90 cm, 2 NISP), Nile perch (SL: 40–50 cm, 1 NISP), sharks, barracuda (60–70, 1 NISP) and mullets (SL: 25–30 cm, 1 NISP) were the identified fish for 21 NISP and 8 MNI.

Discussion

Husbandry management

ECONOMY PATTERN

In the ‘Maison aux Albâtres’, according to the archaeozoological analysis, caprine husbandry was dominant with no preference found

for either sheep or goats (sheep 14.3%, goats 13.7%). Current observations and the zooarchaeological studies suggest that domestic herds were composed of a majority of adult females (Helmer 2000b). This could be the case for the MA assemblage, according to the culling profiles and the recorded pathologies related to age, although the bone sample did not provide sex-ratio information. The culling profiles of the caprine indicate a mixed breeding of sheep directed towards the production of meat, wool and fleeces, whereas goats exploitation appear to be specialised in the production of milk. Such a profile could correspond to the needs of urban consumers, in cities where sub-adult and adult individuals were consumed for their products in a tendency towards maximum exploitation in which breeding was not a priority. One would expect in the case of pastoral breeders a profile with more young animals for example, which is not the case for the MA profiles.

Table 14.8. Sheep/goats and cattle abundance on the Levantine sites

<i>Sites/ NISP</i>	<i>Sheep/ goats</i>	<i>Cattle</i>	<i>NISP (sheep/goats + cattle)</i>	<i>NISP total</i>	<i>Ref.</i>
1 Tell Afis	317	52	369	414	Wilkins 2000
2 Mishrifeh-Qatna	4567	375	4942	6324	Vila (unpublished data)
3 Sirkeli Hoyuk	151	206	357	438	Vogler 1997
4 Ras Shamra/Ugarit	2611	1475	4086	4374	Vila 2008a
5 Gindaris	244	73	317	370	Vila & Dalix 2004
6 Tell Tweini (%)	67	33	100	>256	Linseele 2008
7 Kamid el-Loz	6235	3135	9370	9856	Bökönyi 1990
8 Kinrot	280	133	413	443	Helwing 1988/1989
9 Halif	2524	286	2810	3236	in Zeder 1990
10 Jemmeh	3250	687	3937	4021	in Hesse & Wapnish 2002
11 Shiloh	2623	253	2876	2973	Helwing <i>et al.</i> 1993
12 Nahariya	691	93	784	785	Ducos 1968
13 Harasim	711	420	1131	1194	Horwitz 1996
14 Mique-Ekron	1574	582	2156	1962	Lev-Tov 2000
15 Timna	3146	0	3146	3146	Lernau 1988

However, in the preliminary analyses of the fauna from other buildings of Ras Shamra (Vila 2008a), we notice that culling patterns indicate meat consumption followed by the exploitation of lifetime products. There are higher frequencies of younger animals indicating a preference for tender meat at Ras Shamra/Ugarit which was probably not demanded in the MA. This assemblage may reflect the consumption waste of the inhabitants of the ‘Maison aux Albâtres’ who were probably firstly ‘consumers’ (cf. Stein 1987, notion consumers vs producers).

The dependence on sheep and goat meat and products had become a traditional practice in all the Near East. This tendency for antemortem specialisation is well shown in the evolution of caprine husbandry during the Bronze Age in the northern Levant (Helmer *et al.* 2007) as well as in central Anatolia (Arbuckle *et al.* 2009).

Due to the greater carcass weight, the cattle provided significantly more meat than the caprine, and therefore figured more importantly in the food consumption and the subsistence economy of the inhabitants of the MA.

Sheep, goats and cattle were the main animals exploited and consumed. In comparison with the faunal spectrum studied by Vila (2008a; 2008b) from many buildings of Ras Shamra, grouping together remains from old and recent excavations, animal exploitation in the MA fits into the subsistence pattern of the city in term of caprine and cattle frequencies ([Table 14.8](#)).

Body part frequencies for the three main pastoral animals, as well as the butchering marks associated with primary carcass dismemberment and disarticulation, suggest that whole carcasses were butchered/consumed on site.

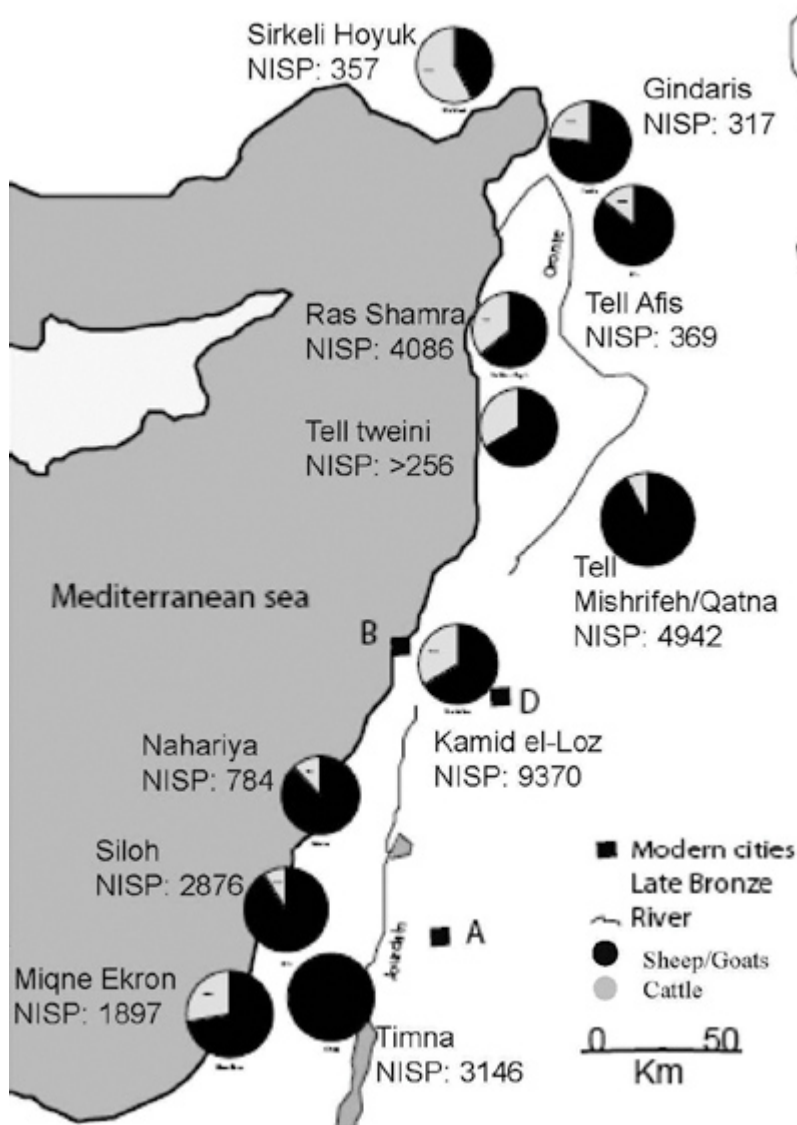


Fig. 14.7. Frequency of sheep/goats and cattle distribution in the Levant (cf. Table 14.8).

In a general look at the management of this trio in the Levant, the subsistence economy of Ras Shamra is no different from other coastal sites in terms of the preference of caprine over cattle in the economy of the Late Bronze Age cities. Sheep, goats and cattle are the most frequent domestic animals on the majority of the southern Levantine sites, according to Horwitz & Milevski (2001) and of the northern Levantine sites during the Late Bronze Age (1600–1200 BC): Ras Shamra, Tell Kazel, Tell Tweini in Syria ; Kamid el Loz and Sidon in

Lebanon ; Sirkeli Hoyuk and Lidar Hoyuk in Turkey (Fig. 14.7). The variability between the various sites could be related to geographic and environmental differences together with influences of site function, society culture and undoubtedly to the size of the bone remains sample.

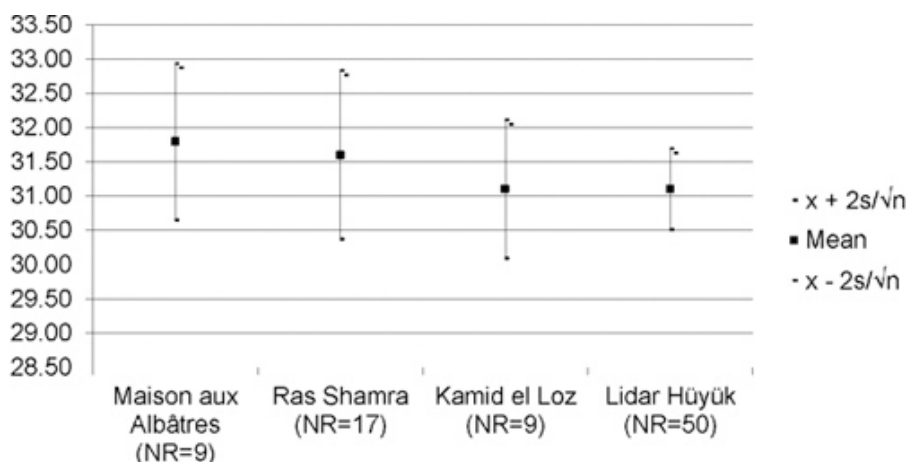


Fig. 14.8. Size variation of sheep (*Astragalus*, GL; cf Table 14.9).

BREEDING SELECTION

Variations in the size of sheep occurred in the Near East over time. The sheep of the Early and Middle Bronze Ages are less robust and smaller in size, whereas those of the Late Bronze Age in Syria are slightly larger and thinner (Vila 2002). For this latter period, a fluctuation in the size of the sheep among Levantines sites is perceived. Measurements taken on astragali³ show that the MA sheep are in the range of variability of the Ras Shamra specimens (Fig. 14.8). On the other hand, they appear to be slightly larger than the Kamid-el Loz (Lebanon) sheep and less robust than the Lidar (Turkey) sheep.

Although the causes of sheep size variation can also be related to environmental and climatic adaptation, they are mostly due to human breeding selection. The average size and the relative slenderness of the sheep from this site could probably be related to the exploitation of wool, observable in the culling pattern. In the Late Bronze Age, more than one type of sheep appears, according to bone remains from Levantine cities. Different breeds of sheep were already known in Mesopotamia according to textual sources from the 3rd millennium BC. The breeding improvements which had begun very early along with the commercial trade network between the Levant, Cyprus, Egypt and Mesopotamia could have been the reason behind this diversity of

sheep and their different body size.

Meanwhile, according to measurement of cattle astragali, the size distribution shows no significant difference in cattle size between the MA building and the cattle of Turkish coastal sites (Sirkeli Hoyuk: Vogler 1997) (Fig. 14.9). The MA cattle specimens appear to be smaller compared to the smallest cattle of LBA Kamid el-Loz site in the Lebanese mountains (Bökönyi 1990) except for two larger astragali. In Kamid el-Loz, the author suggested the presence of at least three different breeds or types among the cattle: a zebu (*Bos cf. indicus*), a large humpless type as well as a small one, also probably humpless. In the preliminary study of animals remains from Ras Shamra (Vila 2008a), the analysis of *Bos* metacarpial could show the exploitation of three types of cattle with different dimensions, probably related to sexual dimorphism: cows of small size, oxen of average size and castrated bulls of larger size. The measurements, taken from ten astragali of cattle from the MA assemblage, show differences in size and may suggest the exploitation of three different types of cattle. Two types of cattle, one for consumption and the other for labour, were suggested for Ras Shamra according to textual sources (Yon 1997). Consumption of cattle meat is indicated by the butchering marks on the smaller and youngest individuals, and the draught cattle are represented by the larger and older individuals with pathological abnormalities.

According to these primary observations, it may be suggested that human subsistence during the Late Bronze Age in the northern Levant, characterized by structured and well-organized cities, was focused on exploiting secondary animal products to satisfy consumer demand for goods and services. Animal husbandry and zootechnical practices were primarily aimed at the consumption of 'ante-mortem' (lifetime) products (ie: milk, fleece, wool).

Exploitation of the environment

HUNTING

The frequency of fallow deer remains in an archaeological assemblage depends on the environment surrounding the site and the activity of its inhabitants. This game (*Dama mesopotamica*) is the most frequent in the Levant during the Late Bronze Age (Vila & Dalix 2004; Dalix & Vila 2007). In a comparison with examples from archaeological and prehistoric sites in Turkey (Vogler 1997, 153) and Cyprus (Ducos 1965) and with modern species in Israel/ Iran (Pfeiffer 1999, 133), we note that the MA fallow deer are slightly larger, and that both MA

specimens could be attributed to males. There are not enough deer remains to determine, based on body part distribution, cut marks and fused post-cranial bones, whether the carcass was butchered outside the city and only consumed on the site. It does seem that some parts of the fallow deer were selected (antler and astragali) for cultural, handcraft and religious purposes and not especially for meat consumption. Polished astragali found in the MA assemblage are similar to others found on the Ras Shamra site recorded by Vila (2008a) and Desse (1982) and could be related to technical and cultural purposes (Dalix & Vila 2007). Deer astragali may possess a symbolic dimension, as could be the case for caprine ankle bones too, as some were found in funerary contexts such as at Tell Mishrifeh (Vila 2011).

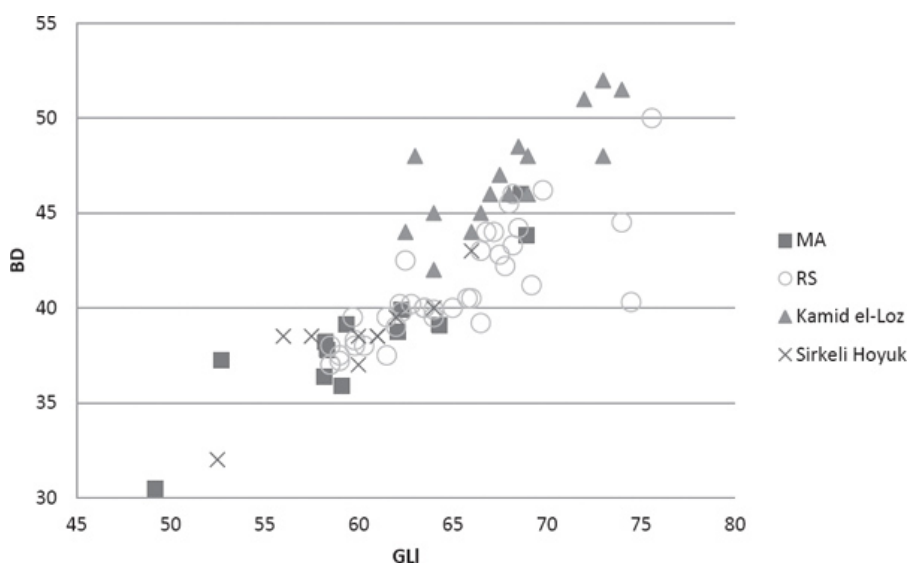


Fig. 14.9. Distribution of measurement of cattle astragali (MA, NISP: 12; cf. Table 14.9).

In the fauna of a given site, the percentage of wild boar as game and that of the pig as a domesticated animal differ among the periods. During the LBA, the consumption of pig decreases and even disappears compared to the earlier and later periods, on certain Levantine sites (Sirkeli Hoyuk in Turkey; Tell Afis, Gindaris and Qatna in Syria; Kamid el Loz in Lebanon: cf. Vila & Dalix 2004). The domestic pig is present in the fauna of Ras Shamra in the Neolithic and Chalcolithic periods (Poulain 1978), whereas it is completely unrecorded in the LBA site fauna, as well as in the MA (Vila, 2008a). This absence does not seem related to the climatic and environmental conditions of the

site, because the environment in this Syrian area is favourable to breeding (Vila 2006a, 2006b). Is it a food choice? It should be noted that the food economy is based primarily on sheep, goats and cattle and apparently pig husbandry was not practised or at least was not yet recorded. On the other hand, the wild boar is present but in low frequency in this assemblage. The activity of wild boar hunting is rare, 0–1% of the remains (Kamid el Loz in Lebanon, Tell Afis and Ras Shamra in Syria: cf. Vila & Dalix 2004). The wild boar appears at Ugarit as a species hunted and consumed on the site and as an element of the magical and religious bestiary. The boar as a decorative motif is shown as ‘an animal with horn’ (Poplin 2000) on pottery remains from Ras Shamra. It was also mentioned in iconographic and textual data from Ugarit related to cultural/religious practices (Vila & Dalix 2004; Dalix 2006); some of its bone elements are considered as trophies, for example in Lidar Hoyuk in the Late Bronze (Kussinger 1988). We can suggest that the presence of wild boar remains in the MA was possibly related to ritualised practices (hunting, preferred meat) rather than to the vital needs in meat resources of the local populations.

The brown bear was recorded in the fauna of the Neolithic settlement of Ras Shamra (Poulain 1978). Some remains were found in some LBA excavated areas of the site (Vila 2008a; 2008b). The most impressive are the finds of teeth (mostly canines) in the Royal Palace. The presence of phalanges and canines in the MA probably does not indicate consumption of bears by the inhabitants. These remains are often related to the presence and use of the skin, which could be the case in the MA, especially as circular cut marks were recorded on these phalanges. Teeth and especially canines could have held special value, as the concentration in the Royal Palace seems to indicate.

Hunting seems to have been of minor importance to the diet of the inhabitants of the MA. Indeed, wild fauna (deer, wild boar and bear) represent only 1% of the mammal remains. The preliminary studies of faunal remains of the other excavated areas in Ras Shamra confirm this observation. The frequencies of wild animals are in general not very high in the LBA Levantine sites. Frequencies of wild fauna in the Syrian LBA sites do not exceed 10%, with 6% for Tell Afis (Wilkens 2000), 9% for Umm el Marra (Schwartz *et al.* 2000; Weber 2006) and 5% in the fauna of Mishrifeh (Vila & Gourichon 2007). Hunting is thus not a source of food for ‘daily’ needs, but more likely related to socio-cultural and religious practices.

Fish contributed to the diet of the inhabitants of the 'Maison aux Albâtres' and indicate the potential for exploitation of marine resources. Fish were probably caught close inshore, indicated by the presence of sea bream (Sparidae) and barracuda (Sphyrænidae) but farther offshore too, seen in the presence of large groupers (*Epinephelus* sp.), jacks (Carangidae) and sharks.

Although various fishing grounds were exploited, imported fish played an important role in the economy of the society. The importation of Mediterranean and Nilotic fish was practised in the Levant during the LBA, because of the proximity of the coast and the existence of efficient trade networks with Egypt (Van Neer & Ervynck 2002; Van Neer *et al.* 2005). The transport of these fish is documented and recorded among the prestigious goods and products of luxury; iconographic data from Pharaonic Egypt mention the Nile perch as dried and smoked, a probable way of conservation for transport on trade routes (Van Neer & Ervynck 2002).

Conclusion

During the Late Bronze Age (1600–1200 BC) the city of Ugarit flourished and became a powerful kingdom. The inhabitants of this city probably belonged to a privileged society. The 'Maison aux Albâtres' is a private residence that was occupied by Egyptian senior officials. Generally, the food economy of the occupants of the site depended on livestock husbandry. What the preceding observations suggest is that this MA assemblage may be 'representative' of a larger entity such as the subsistence pattern of an archaeological culture during the Late Bronze Age in the northern Levant, at least at the city of Ugarit; the favoured husbandry of caprine was intended to produce lifetime products, cattle were selected for meat and for labour, and the hunting of wild animals was strongly related to sociocultural practices and exploitation of the environment. Ongoing studies on various LBA Levantine sites like Sidon, Tell Kazel, and Tell Iris will provide us with a better understanding of animal exploitation on LBA sites in the northern Levant and make it possible to compare several assemblages in order to discern the influences of traditions, food practices, and cultural and political factors on the subsistence economy of LBA society.

Table 14.9. Table of measurements in mm.

Scapula	Species	GLP	BG	LG
243	<i>Capra hircus</i>	23	32	22
244	<i>Capra hircus</i>		34	24
246	<i>Capra hircus</i>	28	37	24
249	<i>Capra hircus</i>	27	33	20
250	<i>Capra hircus</i>	24	35	23
252	<i>Capra hircus</i>			21
253	<i>Capra hircus</i>			19
266	<i>Capra hircus</i>			16
458	<i>Capra hircus</i>	27	32	24
3	<i>Ovis aries</i>	23	30	18
200	<i>Ovis aries</i>	31	36	22
248	<i>Ovis aries</i>	24	32	18
254	<i>Ovis aries</i>			
367	<i>Ovis aries</i>	20	30	20
240	<i>Bos taurus</i>	52	64	41
772	<i>Bos taurus</i>			24

Humerus	species	Bd	SD	Bt
60	<i>Capra hircus</i>	29	14	30
459	<i>Capra hircus</i>	28		29
61	<i>Ovis aries</i>	27		28
62	<i>Ovis aries</i>	34		34
279	<i>Ovis aries</i>	31	16	32
280	<i>Ovis aries</i>	31		30
281	<i>Ovis aries</i>		16	
417	<i>Ovis aries</i>	30		30
418	<i>Ovis aries</i>	31		
742	<i>Ovis aries</i>			
65	<i>Capra/Ovis</i>			
69	<i>Capra/Ovis</i>	20	10	

Ht: maximum height of trochlea

Ht: minium height of trochlea

<i>Astragalus</i>	<i>Species</i>	<i>GLm</i>	<i>Bd</i>	<i>DI</i>
410	<i>Capra hircus</i>	27.97		15.88
193	<i>Capra hircus</i>	27	18.88	14.89
190	<i>Capra hircus</i>	26.68	18.34	14.68
343	<i>Ovis aries</i>	28.6	18.25	15.89
411	<i>Ovis aries</i>	28.51	19.44	15.66
412	<i>Ovis aries</i>	31.55	20.54	16.93
187	<i>Ovis aries</i>	32.08	22.21	19.95
188	<i>Ovis aries</i>	31.06	22.14	18.84
189	<i>Ovis aries</i>	30.85	21.13	16.27
191	<i>Ovis aries</i>	33.9	21.68	14.36
192	<i>Ovis aries</i>	30.32	21.11	17.68
409	<i>Capra/Ovis</i>	29.27	17.63	15.3
345	<i>Capra/Ovis</i>	26.89		14.72
181	<i>Bos taurus</i>	59.09	38.73	33.12
182	<i>Bos taurus</i>	55.91	38.22	33.72
179	<i>Bos taurus</i>	49.67	37.24	30.37
178	<i>Bos taurus</i>	54.99	37.8	32.27
177	<i>Bos taurus</i>	52.35	36.38	31.93
176	<i>Bos taurus</i>	54.99	35.89	33.12
175	<i>Bos taurus</i>	54.51	39.14	32.6
174	<i>Bos taurus</i>	59.81	45.99	36.44
173	<i>Bos taurus</i>	56.4	39.91	33.91
408	<i>Bos taurus</i>	64.6	43.83	38.71
349	<i>Dama mesopotamica</i>	44	29.34	26.19
414	<i>Dama mesopotamica</i>	41.69	23.86	23.75

<i>Meta- carpus</i>	<i>Species</i>	<i>GL</i>	<i>Dp lat.</i>	<i>Bp lat.</i>	<i>Bp</i>	<i>Dp</i>	<i>SD</i>	<i>Bd</i>	<i>DD</i>	<i>Dd</i>	<i>Dd Condyl medial</i>	<i>Dd min condyl med</i>
136	<i>Capra hircus</i>	100.62	10.85	8.85	21.2	15.61	15.54	26.07	9.42	15.42	15.71	10
137	<i>Capra hircus</i>	113.59	12.99	11.37	25.44	18.7	15.51	28.43	10.72	16.42	16.07	10
135	<i>Capra hircus</i>	107.74	12.66	11.36	24.19	16.87	16.83	27.51	9.79	16.29	16.03	10
134	<i>Capra hircus</i>	99.49	12.27	11.43	25.37	18.33	15.71	26.33	10.21	13.66		
138	<i>Capra hircus</i>	114.07	12.84	9.9	23.71	16.55	14.51	26.54	9.82	14.92	15.77	9
139	<i>Capra hircus</i>	113.09	12.9	9.25	23.3	17.67	15.97	27.06	9.71	15.97	16.14	10
140	<i>Capra hircus</i>		14.18	11.72	27.8	19.3						
362	<i>Capra hircus</i>		11.84	10.37	22.83	16.14	15.48		9.14			
364	<i>Capra hircus</i>		14.94	12	21.19	18.4						
455	<i>Capra hircus</i>				41.38		18.13					
141	<i>Capra hircus</i>	57.15	9.65	7.34	18.82	12.27	19.81	11.09	6.9			
1154	<i>Capra hircus</i>							26.28				
142	<i>Ovis aries</i>		11.01	8.77	23.92	17.82	14.54		12.53			
143	<i>Ovis aries</i>	134	13	9.73	25.45	17.63	14.58	28.75		10.64		
144	<i>Ovis aries</i>	132.52				17.93	14.57			10.93		
145	<i>Ovis aries</i>	131.54	13.04	10.87	25.58	18.92	15.36			10.68		
146	<i>Ovis aries</i>		13.9	10.86	26.81	19.53	16.62			13		
147	<i>Ovis aries</i>	149.68	11.56	10.44	25.17	10.86	15.27	29.34	10.41	18.2	18.74	13.11
148	<i>Ovis aries</i>	125.45	13.02	9.12	26.12	19.91	14.21		10.72			
149	<i>Ovis aries</i>							28.91	10.46	17.34	17.36	12.84
150	<i>Ovis aries</i>							31.34	11.81	20.44	20.5	15.27
300	<i>Ovis aries</i>		13.14	10.67	24.99	17.08						
301	<i>Ovis aries</i>		12.51	10.28	22.6	16.68						
404	<i>Ovis aries</i>						13.95	25.7	11.22	16.87	17.17	12.47
308	<i>Capra/Ovis</i>						10.44		6.53			
309	<i>Capra/Ovis</i>						7.78		6.55			

<i>Meta- tarsus</i>	<i>Species</i>	<i>GL</i>	<i>Dp lat.</i>	<i>Bp lat.</i>	<i>Bp</i>	<i>Dp</i>	<i>SD</i>	<i>Bd</i>	<i>DD</i>	<i>Dd</i>	<i>Dd condyl med</i>	<i>Dd min condyl med</i>
151	<i>Capra hircus</i>	109.7	15.35	9.08	19.49	18.21	13.18	13.57	9.87			
152	<i>Capra hircus</i>		15.31	87.27	19.11	18.95	14.05					
153	<i>Capra hircus</i>			8.27	21.39		12.4			13.51		
161	<i>Capra hircus</i>							24.19	10.04	15.6	15.93	10
154	<i>Ovis aries</i>	172.64	20.32	8.33	22.63	22.51	13.53	26.69	13.65	18.51	17.74	10.3
155	<i>Ovis aries</i>	166.83	18.73	7.29	21.99	22.05	1.13	25.46	12.6	17.71	16.89	10.55
156	<i>Ovis aries</i>	167	19.1		23.1	24.56	12.85		12.24	17.58	17.51	11.44
158	<i>Ovis aries</i>		18.88	11.25	25.01	24.03	14.28		14.44			
159	<i>Ovis aries</i>	136.08	17.2	8.95	20.26	19.45	11.78		10.99	14.6		10.79
160	<i>Ovis aries</i>	166.75			21.53		14.58	26.8	12.25	18	17.66	11.34
202	<i>Ovis aries</i>		14.3	8.5	21.04	19.15						
203	<i>Ovis aries</i>		15.58	8	18.78	17.2						
204	<i>Ovis aries</i>						14.66		12.08			
769	<i>Ovis aries</i>		18.46	10.05	21.2	21.34	14.14		13.41			
421	<i>Capra/Ovis</i>										15.43	8.67

<i>Meta- carpus</i>	<i>species</i>	<i>GL</i>	<i>SD</i>	<i>BD</i>	<i>DD</i>	<i>Dp lat.</i>	<i>Bp lat.</i>	<i>Bp</i>	<i>Dp</i>	<i>Dd</i>	<i>Bd art</i>	<i>Dd condyl med</i>	<i>Dd min condyl med</i>
167	<i>Bos taurus</i>		18.64		15.29								
168	<i>Bos taurus</i>										19.37	23.24	16.38
166	<i>Bos taurus</i>			50.28						28.1	22.19	28.41	23.22
165	<i>Bos taurus</i>	175	31.69	51.7	24.73	26.87	21.4	52.39	31.86	28.5	24.92	30.21	22.3
164	<i>Bos taurus</i>	173	31.77	55.15	24.27		20.51	53.54	33.62	29.1	27.71	29.65	25.23
<i>Metatar- sus</i>	<i>species</i>	<i>GL</i>	<i>SD</i>	<i>BD</i>	<i>DD</i>	<i>Dp lat.</i>	<i>Bp lat.</i>	<i>Bp</i>	<i>Dp</i>	<i>Dd</i>	<i>Bd art</i>	<i>Dd condyl med</i>	<i>Dd min condyl med</i>
169	<i>Bos taurus</i>	200.6	28	55.27	27.26	43.03	17.93	45.7	42.71	30.54	30.9	31.87	25.18
170	<i>Bos taurus</i>		25.23		26.63	35.76	18.99	42.03	41.55				
171	<i>Bos taurus</i>	200	30.2	52.74	27.2					28.74	25.94	27.6	23.61
172	<i>Bos taurus</i>		24.77		27.37			43.95	41.52				

<i>Lower premolar 2</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
987	<i>Capra hircus</i>	6.52	7.75	12.34	6.31	6.68
912	<i>Capra/Ovis</i>	3.14	5.94	11.1	4.7	3.94
1024	<i>Bos taurus</i>	6.42	11.45	14.6	11.41	8.33
<i>Upper premolar 2</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
986	<i>Capra/Ovis</i>	6.97	7.42	9.03	7.26	7.04
988	<i>Capra/Ovis</i>	8.33	8.01	16.42	6.31	7.79
1042	<i>Bos taurus</i>	11.03	17.46			
<i>Lower premolar 3</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
911	<i>Capra hircus</i>	6.18	8.72	13.56		
913	<i>Capra hircus</i>	5.43	8.11	11.34	6.63	5
914	<i>Capra hircus</i>	4.11	8.23	12.65	6.29	5.79
952	<i>Capra hircus</i>	4.9	9.3	15.44	8.64	6.49
965	<i>Capra hircus</i>	9.59	8.39	5.75	7.65	6.28
1959	<i>Capra hircus</i>	5.57	8.39	14.1	8	5.5
949	<i>Ovis aries</i>	4.89	9.03	11.75	8.3	6.24
1025	<i>Bos taurus</i>	9.99	16.33	15.1	13.29	9.66
<i>Upper premolar 3</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
989	<i>Capra/Ovis</i>	8.43	10.25	18.62	7.93	9.34
990	<i>Capra/Ovis</i>	10.44	8.6	10.34	7.86	10.56
991	<i>Capra/Ovis</i>	10.34	9	21.55	8.3	11.43
994	<i>Capra/Ovis</i>	9.32	9.01	14.1	7.96	10.04
1078	<i>Capra/Ovis</i>	8.8	8.85	19.93	8.4	9.9
1039	<i>Bos taurus</i>	16.63	17.46	28.95	14.94	17.42
1040	<i>Bos taurus</i>	13.6	17.81	23.44	15.7	15.28
1041	<i>Bos taurus</i>	15.85	16.64	26.96	13.67	18.1

<i>Lower premolar 4</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
917	<i>Capra hircus</i>	6.04	10.66	20.3	9.2	7.1
923	<i>Capra hircus</i>	6.03	10.52	17.37	9.61	6.87
924	<i>Capra hircus</i>	6.06	10.43	15.09	9.09	6.78
925	<i>Capra hircus</i>	6.75	10.81	18.22	9.9	7.25
966	<i>Capra hircus</i>	7.07	10.39	6.72	9.14	7.16
1064	<i>Capra hircus</i>	6.37	11.9		10	6.81
1095	<i>Capra hircus</i>	6.4	10.11	12.12	8.66	6.96
1096	<i>Capra hircus</i>	7.63	11.29	9.59	10.73	7.74
922	<i>Ovis aries</i>	7.46	9.9	14.55	7.43	7.24
927	<i>Ovis aries</i>	6.93	9.66	12.33	9.13	7.41
954	<i>Ovis aries</i>	6.28	10.48	16.96	9	7.14
1026	<i>Bos taurus</i>	11.35	20.39	15.86	17.41	12.01
<i>Upper premolar 4</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
992	<i>Capra/Ovis</i>	10.64	8.22	9.45	8.24	9.92
993	<i>Capra/Ovis</i>	9.51	8.51	7.99	7.86	9.86
1079	<i>Capra/Ovis</i>	10.89	8.64	17.8	8.55	11.25
1534	<i>Capra/Ovis</i>	9.41	8.22	17.34	6.3	8.97
1075	<i>Bos taurus</i>	16.32	16.59	22.05	16.17	16.46
<i>Lower molar 1</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
919	<i>Capra hircus</i>	7.26	14.21	22.49	11.88	8.34
926	<i>Capra hircus</i>	7.24	11.68	11.54	10.8	7.59
928	<i>Capra hircus</i>	8.1	10.74	5.73	10.94	8.29
929	<i>Capra hircus</i>	8.48	12.72	15.4	11.69	8.84
931	<i>Capra hircus</i>	7.11	11.93	14.81	10.66	7.61
933	<i>Capra hircus</i>	8.97	13.59	13.6	12.41	9.1
940	<i>Capra hircus</i>	7.57	14	22.74	13.1	8.44
1019	<i>Capra hircus</i>	6.97	14.46	27.4	11.35	7.38
1055	<i>Capra hircus</i>	7.86	13.44	18.52	12.18	8.55
1060	<i>Capra hircus</i>	7.64	12.12	16.29	10.26	6.82
930	<i>Ovis aries</i>	7.84	13.03	16.35	11.8	7.95
932	<i>Ovis aries</i>	9.11		23.66	12.51	9.07
934	<i>Ovis aries</i>	8.31		16.17	11.15	8.17
941	<i>Ovis aries</i>	7.8	15.26	25.25	10.96	7.71
957	<i>Ovis aries</i>	7.59	10.18	7.5	9.66	7.26
1029	<i>Bos taurus</i>	13.56	19.96	18.12	18.64	14.19

<i>Lower molar 2</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
920	<i>Capra hircus</i>	8.11	18.4	33.87	12.98	8.71
935	<i>Capra hircus</i>	7.56	14.12	23.44	12.31	8.41
937	<i>Capra hircus</i>	6.28	17.69		13.23	8.15
939	<i>Capra hircus</i>	8.79	15.14	22.41	13.1	9.45
943	<i>Capra hircus</i>	8.21	15.13	28.94	13.3	9.03
946	<i>Capra hircus</i>	7.85	18.95	33.66	14.44	9.41
947	<i>Capra hircus</i>	6.4	17.9			
961	<i>Capra hircus</i>	8.72	23.73	23.11	21.59	8.84
1017	<i>Capra hircus</i>		19.2	39.63	16.72	10.49
1020	<i>Capra hircus</i>	8.13	18.21	35.78	15.13	9.49
1054	<i>Capra hircus</i>	8	18.34	38.24	15.27	9.08
1057	<i>Capra hircus</i>	8.65	14.92	25.11	13.4	8.52
1058	<i>Capra hircus</i>	7.93	171	32.39	14.6	9
1066	<i>Capra hircus</i>	8.48	16.1	30.31	12.97	8.7
936	<i>Ovis aries</i>	9.18	15.75	30.5	13.07	8.79
938	<i>Ovis aries</i>	8.27	18.33	44.59	13.41	8.85
942	<i>Ovis aries</i>	7.8	14.49	28.27	10.72	7.75
944	<i>Ovis aries</i>	8.1	18.49		13.15	8.56
945	<i>Ovis aries</i>	8.57	18.03	36.81	13.82	8.85
958	<i>Ovis aries</i>	8.87	1413	19.16	12.64	8.61
1069	<i>Ovis aries</i>	7.76	18.59	33.32	14.22	8.67
1030	<i>Bos taurus</i>	13.72	22.7	27.32	22.14	15.05
1074	<i>Bos taurus</i>	15.5	28.8		27.49	19.59

<i>Lower molar 3</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
900	<i>Capra hircus</i>	8.65	23.69	27.13	20.81	8.99
901	<i>Capra hircus</i>	8.84	24.35	33.61	24.96	9.43
902	<i>Capra hircus</i>	7.29	21.89	33.67	22.19	8.09
905	<i>Capra hircus</i>	7.9	20.03	40.92	22.65	8.47
906	<i>Capra hircus</i>	8.1	20.93	40.02	22.66	8.76
907	<i>Capra hircus</i>	7.81	22.35	37.09	23.14	9.18
909	<i>Capra hircus</i>	7.57	20.18	25.7	23.26	8.31
921	<i>Capra hircus</i>	8.25	24.74	37.7	23.44	8.76
962	<i>Capra hircus</i>	9.14	13.38	13.81	12.19	9.29
1056	<i>Capra hircus</i>	8.47	20.02	34.05	20.91	7.88
1068	<i>Ovis aries</i>	8.26		31.58		8
903	<i>Ovis aries</i>	8.33	20.8	46.71	24.26	9.01
904	<i>Ovis aries</i>	8.13	20.2	44.39	23.15	9
959	<i>Ovis aries</i>	9.24	24.31	28.87	23.33	8.72
964	<i>Ovis aries</i>	9.56		26.33	24.99	9.31
1065	<i>Ovis aries</i>	8.3		39.53		8.73
1090	<i>Ovis aries</i>	9.67	24.14	26.13	23.42	8.96
1022	<i>Capra/Ovis</i>	6.89	17.26		20.75	12.85
1067	<i>Capra/Ovis</i>	8.4	20.22		22.63	8.28
1031	<i>Bos taurus</i>	13.98	34.51	54.98	36.17	15.28
<i>Upper molar 1</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
997	<i>Capra/Ovis</i>	8.63	14.26	16.36	11.09	9.82
999	<i>Capra/Ovis</i>	10.92	15.31	26.49	13.98	12.33
1002	<i>Capra/Ovis</i>	10.23	15.77	32	11.87	10.97
1544	<i>Capra/Ovis</i>	9.55	16	26.6	12.96	11.71
996	<i>Capra/Ovis</i>	10.47	13.1	23.04	11.03	11.96
1001	<i>Capra/Ovis</i>	12.27	15.08	15.26	14.04	12.42
998	<i>Capra/Ovis</i>	11.81	13.53	17.95	11.7	11.86
995	<i>Capra/Ovis</i>	10.47	16.74	24.61	12.08	12.21
1000	<i>Capra/Ovis</i>	11.82	0	7	10.23	11.6
1047	<i>Capra/Ovis</i>	11.48	12.42	10.67	9.41	11.42
1082	<i>Capra/Ovis</i>	13.5	16.9	24.35	14.09	13.06
1550	<i>Capra/Ovis</i>	10.75	11.27	10.1	9.29	9.94

<i>Upper molar 2</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
1003	<i>Capra/Ovis</i>	8.03	17.2		15.25	12.03
1077	<i>Capra/Ovis</i>	8.98	15.31	23.5	11.81	11.47
1084	<i>Capra/Ovis</i>	10.86	17.04	30.86	11.35	11.91
1536	<i>Capra/Ovis</i>	13.85	15.25	12.25	13.66	13.77
1062	<i>Capra/Ovis</i>	9.11		20.7	16.16	9.79
1006	<i>Capra/Ovis</i>	10.61	18.05	36.78	15.84	12.83
1004	<i>Capra/Ovis</i>	12.49	16.51	23.35	14.51	13.6
715	<i>Capra/Ovis</i>	10.29	15.18	26.03	11.96	11.01
1005	<i>Capra/Ovis</i>	12.94	16.54	18.81	14.21	13.77
1007	<i>Capra/Ovis</i>	10.79	16.71	25.6	11.04	11.69
1008	<i>Capra/Ovis</i>	11	15.75	28.18	11.1	11.73
1046	<i>Capra/Ovis</i>	12.92	15.4	21.96	11.52	12.12
1083	<i>Capra/Ovis</i>	12.44	17.95	32.05	14.16	11.92
1549	<i>Capra/Ovis</i>	11.61	14.47	19.31	12.56	11.38
1053	<i>Bos taurus</i>	9.52	25.33	32.82	24.16	17.15
1089	<i>Bos taurus</i>	22.7	28.8		26.47	24.46

<i>Upper molar 3</i>	<i>species</i>	<i>B</i>	<i>L</i>	<i>H</i>	<i>L (Neck)</i>	<i>B (Neck)</i>
1010	<i>Capra/Ovis</i>	10.29	16.61	37	17.7	12.98
1011	<i>Capra/Ovis</i>	9.74	18.78			18.67
1012	<i>Capra/Ovis</i>	12.4	20.3	34.92	21.81	13.47
1061	<i>Capra/Ovis</i>	11.87	17.7	36.72	18.94	14.27
1537	<i>Capra/Ovis</i>	13.71	18.76	24.43	18.38	15
1009	<i>Capra/Ovis</i>	10.5	16.15	36	14.36	12.84
1013	<i>Capra/Ovis</i>	11.95	18.44	26.68	18.56	12.28
1014	<i>Capra/Ovis</i>	12.51	21.23	19.27	21.23	12.9
1015	<i>Capra/Ovis</i>	12.09	20.01	21.36	19.23	11.72
1016	<i>Capra/Ovis</i>	10.82	17.26		20.75	12.85
1045	<i>Capra/Ovis</i>	12.23	18.64	30.96	20.38	212.98
1085	<i>Capra/Ovis</i>	12.33	20.59	26.8	19.02	11.8
1086	<i>Capra/Ovis</i>	12.67	21.14	36.49	19.23	13.76
1032	<i>Bos taurus</i>	17.59	27.93	40.54	25.56	20.31
1033	<i>Bos taurus</i>	17.87	28.21	40.94	27.25	20.04
1052	<i>Bos taurus</i>	18.48	31.91	32.87	31.88	23.85

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Notes

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- 3 Astragalus may be not the best bone for comparing body size of caprine. Unlike other bones the ankle bone does not have a concrete epiphysial fusion age.
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15. How large a sheep, how big a sample?

Laszlo Bartosiewicz

The reconstruction of animal sizes has been central to traditional archaeozoological inquiry. It is, however, often made difficult due to the lack of sufficiently large sample sizes. Reference collections and methods of size reconstruction also vary. In this paper, a small sample of Late Bronze and Early Iron Age sheep from the Levantine site of Tel Dor is evaluated on the basis of comparative data on Shetland ewes published by Davis (1996), highlighting some of the methodological problems, many stemming from the scarcity of archaeozoological data. As is often the case in research, establishing similarities seems easier in this topic than pinpointing diagnostic differences: a critical evaluation of sheep bone measurements from this site showed no significant diachronic change between the Late Bronze and Early Iron Age periods, an important social and economic transition in the Near East.

Keywords: Tel Dor, Late Bronze Age, Iron Age, Sheep measurements

Introduction

Sampling has long been recognised as crucial in the evaluation of archaeological remains (Ammerman *et al.* 1978, 123). Without proper control or at least knowledge of the often scanty data available for study, many of the conclusions drawn may be superficial if not misleading. Dealing with a special aspect of archaeozoological inquiry, the reconstruction of body size for ancient livestock, most researchers are especially caught between a rock and a hard place. Archaeological assemblages are known to be incomplete and biased, while the nature of modern reference collections also introduces potential noise into comparisons. Metric analyses are of help in clarifying this picture, but

archaeological data do not always lend themselves to testing in formal statistical terms.

In this paper, measurements of Late Bronze and Early Iron Age sheep bones from the ancient port of Tel Dor have been studied in a broad chronological and geographical setting, in order to assess putative changes in the size of these animals that might have paralleled a major shift during the turbulent history of the site.

Site location and historical summary

The ancient harbour town of Dor is located south of Haifa, Israel, on the seafront of the coastal plain between the southern slopes of the Carmel Mountain and the Mediterranean Sea. The site occupies some 15ha on the shore; part of the town (ca. 15%) was even eroded by centuries of wave action. The 14m high, largely artificial mound is located on a more-or-less rectangular, peninsular area. In ancient times the town was thus practically surrounded by water, connected to the coast only by a narrow strip of land. It had three natural harbours in the surrounding lagoons (Stern 1994).

The earliest known occupation of Tel Dor dates to the Middle Bronze Age IIA (ca. 2000–1750 BC), and the settlement was inhabited continuously until the Roman period (ca. AD 250). By that time, Dor was out-competed by the Roman port city of Caesaria established to the south, and largely fell into disuse in Byzantine times.

Of the eight excavation areas (A–H), the animal bone assemblage discussed in this report originates from Area G, located in the very center of the mound ([Fig. 15.1](#)) from where human habitation seems to have spread. No Bronze Age remains are known from the other, more peripherally located excavation areas, opened beyond this central section.

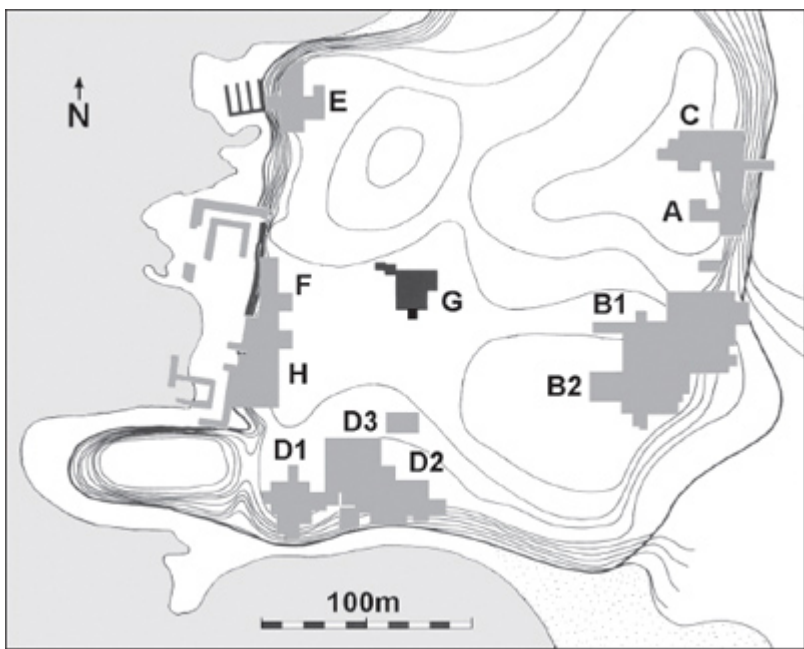


Fig. 15.1. The site plan of Tel Dor with areas excavated 1980–2000. Area G is located in the centre (Redrawn and updated after Stern 1994, 78, fig. 35).

During most of the Late Bronze Age, the entire region under discussion here operated under strong Egyptian influence (Gonen 1992, 214). Around 1200 BC, Dor seems to have been overrun by the Sikil or Sea People. In the Sharon region, where Dor is located, the Wen-Amun papyrus refers to Sikil intrusion as well (Mazar 1992, 280). During Phase 10 part of Area G served as a smithy used for the recasting of metal objects (Berna *et al.* 2007) during the Iron Age (as well as in subsequent periods) of the so-called Divided Kingdom (870–733 BC). The latter ended with the destruction of the town, presumably by the Assyrian king Tiglath Pileser III. Shortly after, the city was rebuilt, probably because the landlocked Assyrians had need of the port. Assyrian rule was relatively short, presumably ending around 630 BC (Stern 1994).

Area G was probably the location of the first occupation at the site. As such, detecting any shift in animal exploitation across its stratigraphy may be of interest. Phases 12–11 largely represent the Late Bronze Age II (14–13th and potentially 12th century BC as shown by the relative chronology of pottery styles). Sheep and goat seemed equally important providing approximately one quarter of the bone weight represented at the site.

Phases 10–9 belong to the Early Iron Age 1a. Phase 10 must have

largely corresponded to the 11th century BC. A large building had been built that subsequently underwent numerous changes (extending into Phases 9–6) and a major destruction toward the end of the Iron Age II. Phase 9 (Iron Age 1a, late) shows continuity with Phase 10 underneath (11th and possibly early 10th century BC). In this increasingly structured space several sealed deposits survived resulting in a lesser degree of fragmentation in the bone material.

Although another phytolith-rich layer was discovered inside this built-up space within the large building, at the end of Phase 9 the area had suffered a major destruction (ca. 1000 BC; e.g. Berna *et al.* 2007). Animal remains from these deposits indicate that the significance of sheep and goat exploitation became relatively important at the time. The top layers of Area G were poor in datable animal remains.

Material and method

Elicia Lisk (1999) studied Iron Age and later animal bones from Area G at Tel Dor in her MSc thesis. By 1999, excavations in Area G have recovered the most complete chronological sequence from the Iron Age occupation. The deepest, Late Bronze Age layers, however, were still to be excavated. After 1999, I recorded 4411 animal remains (3275 identifiable) and integrated them with the previously collected data, thereby completing the documentation of faunal material from Area G. These pooled results were sub-divided according to the final (2008) archaeological phasing of the site that has been thoroughly revised since the first comprehensive analysis of the animal remains (Lisk 1999).

Bone collection from Area G took place over several seasons, with varying intensity and resolution. Lisk (1999, 69) had initiated both dry (5mm mesh) and water-sieving (2mm mesh), in phases 9 and 10 of the Iron Age 1a horizon. A much larger proportion of Late Bronze Age Phases 11–12 were sieved during the 1999–2000 field seasons under the supervision of this author. While the use of sieving or the lack thereof may affect the age composition of caprine bone samples (e. g. through the differential loss of bones from newborn/infantile lambs), measurable sheep/goat bones usually represent a size range that tends to be recovered even by hand (Bartosiewicz 1988). Most of the specimens investigated here indeed originate from the hand-collected material.

The relatively small, partially recovered Persian, Hellenistic and Roman period chronological sub-sets from Area G appear to be of minor significance from the viewpoint of the Late Bronze and Early Iron Age cultural transition. This paper therefore, concentrates on the

diachronic aspects of sheep husbandry in the rich prehistoric assemblage with special regard to the Bronze Age-Iron Age transition. Measurements of sheep bone from the relevant, lowermost strata – all taken by the author – are used in this case study.

Late Bronze Age Phase 12 was represented in several soundings as a massive, largely undifferentiated fill. Phase 11 is present in the form of distinct surfaces. These two provenances provided the overwhelming majority of measurable sheep bones. Early Iron Age Phase 10, however, was also taken into consideration. Given the fundamental nature of tell formation, the taphonomic history of the material is variegated. There are few absolutely clean, sealed contexts. Animal bones from mixed contexts (e.g. Phases labeled ‘later than 6’ or ‘9–10’) were not included in the analysis, with the notable exception of Phases 4 and 5 as well as 7–8 and 9 that were pooled as ‘late material’.

Table 15.1 Summary table of NISP values for macromammalian taxa from Area G at Tel Dor

	4-5	6	7-8	9	10	11-12
Marbled polecat (<i>Vormela peregusna</i> Gldenstdt, 1770)					4	
Badger (<i>Meles meles</i> Linn, 1758)						2
Cat (<i>Felis sylvestris</i> Erxleben, 1777)					2	2
Fox (<i>Vulpes vulpes</i> Linn, 1758)				2	1	1
Large dog or wolf (Canidae)					1	
Dog (<i>Canis familiaris</i> Linn, 1758)		2		2	4	3
Aurochs (<i>Bos primigenius</i> Bojanus, 1827)						38
Cattle (<i>Bos taurus</i> Linn, 1758)	9	57	52	65	401	1029
Goat (<i>Capra hircus</i> Linn, 1758)	1	4	1	1	12	123
Sheep (<i>Ovis aries</i> Linn, 1758)	5	5		1	8	164
Sheep/goat (Caprinae)	10	112	181	333	742	1062
Wild pig (<i>Sus scrofa</i> Linn, 1758)						5
Pig (<i>Sus domesticus</i> Schreber, 1777)		2		5	21	2
Mountain gazelle (<i>Gazella gazella</i> Pallas, 1766)		2	4	6	7	46
Persian fallow deer (<i>Dama mesopotamica</i> Brooke, 1875)		7	16	15	10	39
Domestic ass (<i>Equus asinus</i> Linn, 1758)					6	3
Equid (Equidae)		1				17
Non-identifiable large ungulate	6	9	6	1	36	470
Non-identifiable small ungulate	7	7	2	13	46	295
Total	40	210	265	464	2071	3657

Faunal list and the number of identifiable specimens

During the analysis of bones, standard methods of archaeozoological documentation were followed. The remains of mammalian taxa are summarised in terms of the number of identifiable specimens (NISP) in [Table 15.1](#).

Identifications were possible on different taxonomic levels, usually families or genera, when no species identification could be carried out. In such cases, providing a species name based on uncertain identification would have been misleading, resulting in the 'over-identification' of non-diagnostic bone fragments. The subfamily name Caprinae, is commonly used in archaeozoology to describe non-distinguishable bone fragments of sheep and goat (also sometimes referred to erroneously as 'Ovicaprids', a nonexistent family, as caprines belong to the family of Bovids).

Methods of recording and analysis

During identification, distinctions between the bones of sheep and goat were based on the seminal work by Boessneck *et al.* (1964) wherever possible. Measurements taken on the bones unambiguously attributed to sheep were recorded after von den Driesch (1976). Only measurements of fully fused epiphyses were included in the study, that is, individuals recognised as immature were excluded from calculations. However, given the different ossification regimes of epiphyseal plates in various long bones, only the *terminus post quem* ages of animals could be established, a potential source of distortion seldom addressed in the literature. Real ages at death may well have varied in the sample depending on the skeletal part available for measurement. Epiphyseal ageing was carried out using the tabulated data on modern sheep/goat published by Chaix and Ménéral (2001). Withers heights were estimated using the coefficients devised by Teichert (1975).

Beginning with adopting Simpson's log ratio method (Simpson *et al.* 1960, 356–358), however, a number of methods have been developed by archaeozoologists for the comparison of scant, individual measurements (For a comprehensive summary see Meadow 1999). Following previous attempts by this author (Bartosiewicz 2007, 294), based on those principles the mathematical formula was simplified to using the most commonly available statistical parameters, mean values and standard deviations of a reference collection to calculate standard scores for each measurement taken on the prehistoric specimens from Dor.

The body of reference data used in these calculations were the skeletal measurements from 26 adult Shetland ewes published by Davis (1996). The mean values and standard deviations calculated from this unimproved present-day breed served as a technical background against which individual measurements of fragmentary Bronze and Early Iron Age sheep bones could be plotted within the

same diagram (without implying any direct relation to the modern ewes). The standard scores for each archaeological measurement were calculated from the respective mean value and standard deviation of the same bone in the reference collection of Shetland sheep (Davis 1996, 596, table 2). Modern sheep of even poor conditions were included in the comparison in an effort to appraise the possibly broadest range of phenotypic variability.

This method provides a graphic means by which to compare measurements from sporadically occurring, disarticulated skeletal elements from Dor, scaling significantly from those of the standard values. In other words, if we were to test the differences between the three phases from Dor by pooling measurements of various skeletal elements, in order to increase samples, we may be violating the assumption of homogeneity of size variance, the same way as the log-ratio method cannot be used to mechanically enlarge sample size, unless it can be demonstrated that the skeletal proportions of the populations compared do not differ.

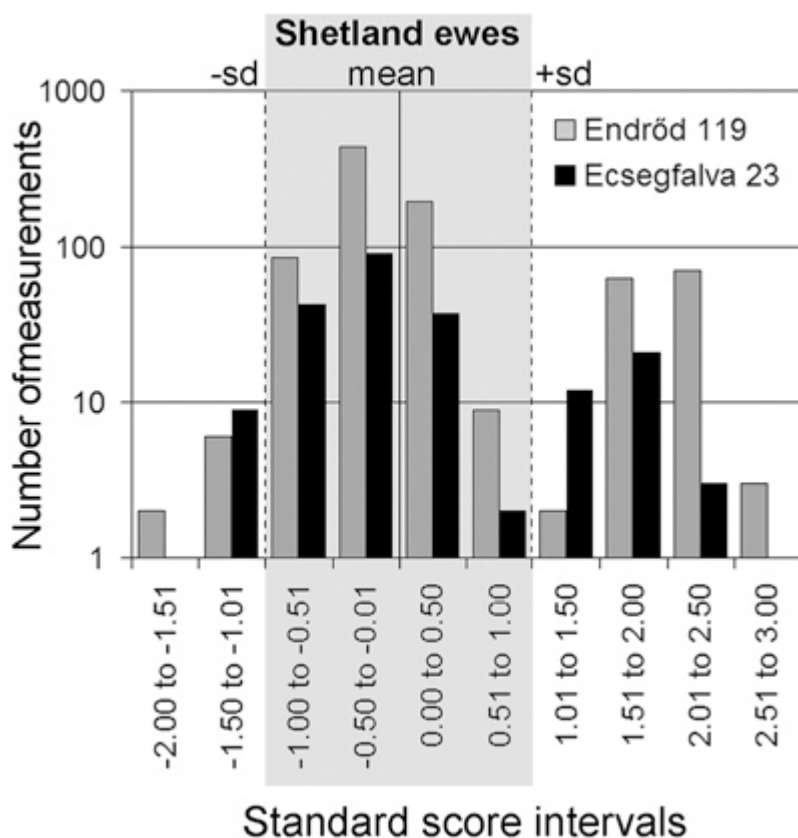


Fig. 15.2. The distribution of sheep bone measurements from two Early

Neolithic sites in Hungary around the mean of Shetland ewes (Davis 1996). Bimodality has been interpreted as the manifestation of sexual dimorphism in the two samples. According to the known sex of Shetland sheep, specimens on the left hand side were tentatively assigned to ewes (Bartosiewicz 2007).

The encouraging case study of various sheep bone measurements from the large Early Neolithic assemblages from Ecsefalva 23 and Endrőd 119 in Hungary (Bartosiewicz 2007, 294, fig. 14.8) has shown a striking morphometric similarity between these meagre individuals kept in a newly colonized marshland habitat in the Great Hungarian Plain and modern Shetland sheep living in similarly unfavourable, humid environments. This paradigmatic similarity shown in [Figure 15.2](#) was taken as a research hypothesis. Feeding individual sheep bone measurements from the Dor sheep bone assemblage into this model, sheep from Phases 10, 11 and 12 were compared in the hopes that a diachronic size change can be detected.

Results and discussion

Species composition

A diachronic comparison between species was first carried out on the basis of NISP values obtained for the economically most important ruminants ([Fig. 15.3](#)). Although late phases yielded relatively few bones, the proportions calculated between the numbers of cattle vs. caprine bones show statistically significant diachronic differences ($\text{Chi}^2=253.175$, $\text{df}=6$, $P \leq 0.000$), that is, the overall decrease in the relative number of cattle bones from the Late Bronze Age (Phases 11–12) to Early Iron Age (Phases 9–10) deposits is indicative of the increasing role played by caprines in the meat diet.

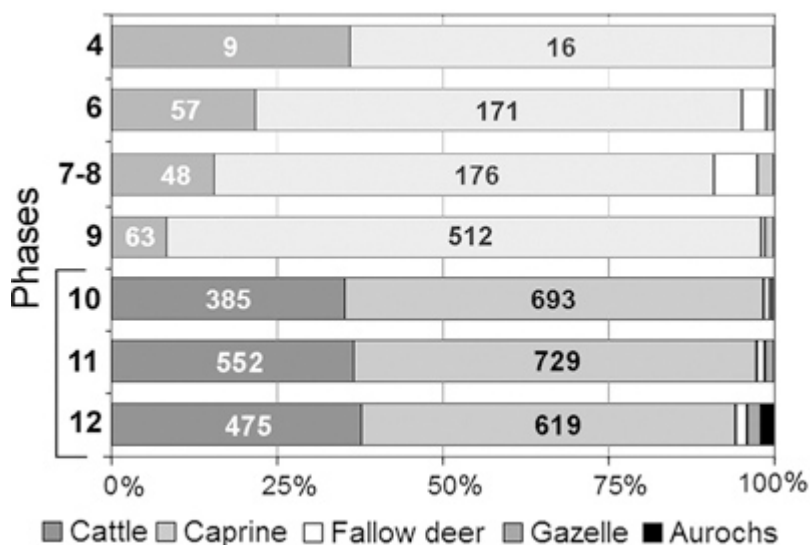


Fig. 15.3. The percentual distribution of ruminant remains (NISP) from various phases at Dor. The highlighted lowermost phases (10–12) have been studied in detail.

Fragment weights were available only from the lowermost strata of Area G detailed in this study. Their brief review is of help in fine-tuning the interpretation of basic trends established on the basis of NISP counts and percentages. Samples of weighed bone fragments yielded the basic parameters summarised by phases and taxonomic groups in [Table 15.2](#).

This tabulated summary shows that while the mean weight of domestic cattle bones varied around 20g through the studied chronological sequence, The mean weight of caprine bones was on average 20% of the value obtained for cattle. It is also noteworthy that in contrast to low NISP values, 66–75% of bone weights in the studied phases 10–12 are made up by cattle remains, showing the importance of beef in the diet, in spite of the modest-looking 10–30% NISP values obtained for cattle. When cattle and caprine bone weights are singled out for comparison, the slight diachronic increase in the contribution of caprine bones is statistically significant ($\text{Chi}^2 = 38.042$, $\text{df} = 2$, $P \leq 0.000$).

Differentiating between sheep and goats

[Table 15.2](#) also shows an important relationship between taphonomy and taxonomic identifiability: recognisable sheep and goat bones are consistently heavier (i.e. on average less fragmented) than those

assigned to the general group, caprine. Identification may be further refined using dental information and – in well-preserved assemblages of adult individuals – bone measurements (Payne 1969; 1985). In addition to the degree of fragmentation and range of methods, inter-observer bias is also likely to influence the success of species-level identification. Therefore, the proportion between bones generally assigned to this subfamily *versus* sheep and goats respectively may vary between broad ranges as shown in [Figure 15.4](#), largely based on the compilation by Raban-Gerstel *et al.* (2008, 46, table 7). Sites in this graph have been sorted by the increasing NISP ratio of goat relative to that of sheep. All phases of Dor, along with Tel Rehov, an Early Iron Age site near the Jordan River (Marom *et al.* 2009), are characterised by the highest proportion of sheep to goat in terms of NISP, and this value also suggests a diachronic increase toward the later phases. The numerical reliability of identified bones increases when the contribution of such fragments is greater relative to those of caprines and when the ratio between sheep and goat approaches extremes (Bartosiewicz 1999). In the case of the data summarised in [Figure 15.4](#), the latter criterion was not met in most cases: especially in large, more representative assemblages, the proportion between identifiable sheep/goat bones is close to 1/1. Nevertheless, the distribution of the two groups of clearly distinguishable bones is heterogeneous in statistically significant terms ($\text{Chi}^2=133.141$, $\text{df}=13$, $P \leq 0.001$).

Table 15.2 A sample of weighed bones (g) showing the quantitative contribution of taxa and mean fragment weights in the three studied phases of Area G at Tel Dor

	Phase 10			Phase 11			Phase 12		
	<i>n</i>	<i>wt</i>	<i>mean</i>	<i>n</i>	<i>wt</i>	<i>mean</i>	<i>n</i>	<i>wt</i>	<i>mean</i>
Cattle	37	783	21.2	466	8817	18.9	477	9154	19.2
Aurochs				13	568	43.7	25	968	38.7
<i>Bovine total</i>	37	783		479	9385		502	10,122	
Caprine	51	255	5.0	511	2210	4.3	481	2027	4.2
Sheep	9	75	8.3	76	814	10.7	88	1033	11.7
Goat	7	87	12.4	71	778	11.0	53	821	15.5
<i>Caprine total</i>	67	417		658	3802		622	3881	
Fallow deer				6	41	6.8	32	567	17.7
Gazelle				16	203	12.7	31	397	12.8
<i>Deer+gazelle total</i>				22	244		63	964	

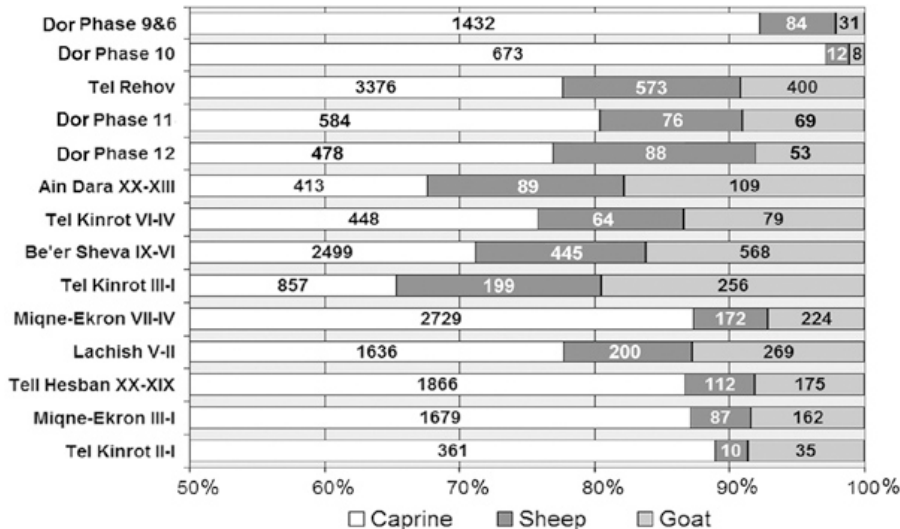


Fig. 15.4. The NISP proportions between non-identifiable caprine, sheep and goats at Late Bronze and Iron Age settlements in the southern Levant, sorted in the decreasing order of sheep/goat ratios.

Bone measurements and age

In the heavily fragmented material from Dor, only a radius (Phase 11, GL=152.1mm) and a metatarsus (Phase 10, GL=121.1mm) were preserved in full length. Withers heights could be estimated as 608.4mm and 546.2mm respectively, using Teichert's (1975) coefficients. These two values, however, are far too few to allow any conclusions regarding Bronze and Iron Ages sheep at Dor. Therefore 113 measurements taken on clearly identifiable sheep bone were compared to the set of skeletons from 26 Shetland ewes published by Davis (1996). The anatomical distribution of skeletal parts studied is summarised in Figure 15.5. The same bones are detailed along with related minimum ages of epiphyseal fusion (Chaix & Ménéil 2001) and by phases in Table 15.3.

The smallest *collum* length of scapula and the smallest diameter of the tibia diaphysis cannot be used in ageing. The rest of the minimum ages, however, are important, as they may influence transversal dimensions of bones. Although measurements have been taken only on completely fused bone fragments at Dor, even such specimens indicate only *terminus post quem* ages if the other epiphysis (missing half) of the same bone is fusing later. Figure 15.6 shows that while all measured sheep bone fragments were fully fused, and deemed adult on the basis of their general state, some may well have originated from potentially younger individuals.

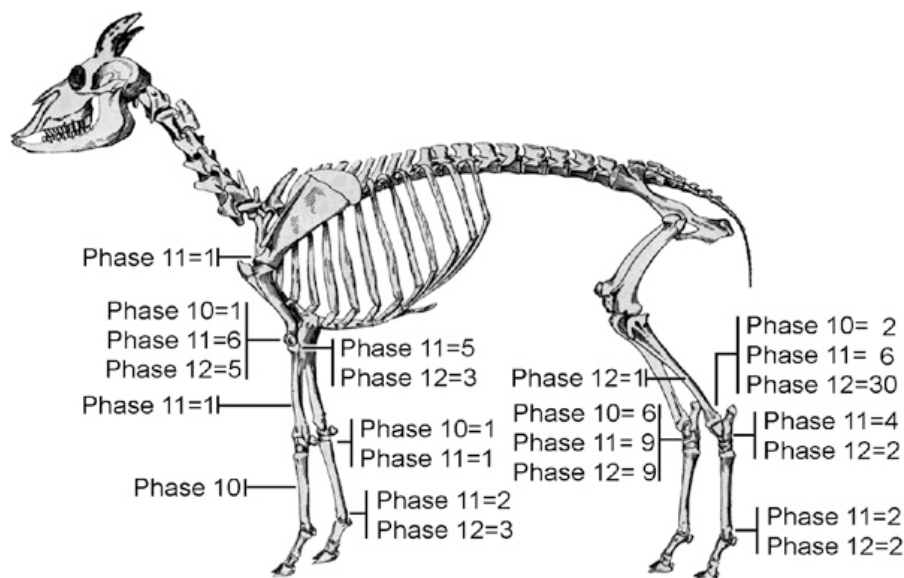


Fig. 15.5. The anatomical distribution of measurable skeletal parts available for study from various phases at Tel Dor.

Table 15.3 Sheep bone measurements studied from Area G at Dor. Asterisks indicate bone parts fused already at the time of birth, but forming only months later (Measurement codes after von den Driesch 1976 & Davis 1996)

	Phase 10	Phase 11	Phase 12	Total	Fusion, mo.
scapula SLC		1		1	—
humerus BT	1	6	5	12	3–4
radius Bp		5	3	8	3–6
radius GL		1		1	23–30
metapodium BFp	1	1		2	3*
metapodium GL	1			1	16–18
metapodium BFd		4	5	9	16–18
tibia Bd, Dd	2	6	30	38	12–18
tibia SD			5	5	—
calcaneus GL		4	2	6	36
astragalus GL, Bd, Dl	6	15	9	30	3*
Total	11	43	59	113	

As background information, [Figure 15.7](#) shows the age distributions of all caprine remains (including dentition) from the three studied phases of Area G at Dor, suggesting that only 15–20% of the ageable

bones originated from younger than adult sheep or goat. Even in fully grown specimens, however, the transversal growth of long bones continues after the cessation of longitudinal growth once the epiphyseal plates have been fused. Finally, mean fusion ages were calculated on the basis of the various times of epiphyseal fusion included in the study. Student's t-tests were carried out to establish potential differences in the age distribution of measurable sheep bones in the three phases of Dor.

Finally, Student's t-tests were carried out to establish potential differences in the age distribution of measurable sheep bones in the three phases of Dor (Table 15.4).

Univariate statistical parameters show that the mean epiphyseal fusion ages of bones represented in the material fell between 6 and 12.3 months, and that differences between the sub-samples by phases were not significant in statistical terms. Measurements were thus comparable between the three phases.

Fragment size distributions

Finally, presuming a homogeneous age distribution for all three sub-samples, individual measurements were plotted against the background of Shetland ewes (Fig. 15.8). The illustration shows that, in spite of the modest representation of data, the measurements of sheep from Dor tend to clearly exceed the mean size of recent Shetland ewes by several standard deviations. Stacked data from Dor are normally distributed (a Kolmogorov-Smirnov test yielded $p > 0.235$), peaking approximately at the +3sd limit of Shetland ewes. Sporadic specimens from pooled phases 6–9 also fit within this trend. Only three outliers occur on the right hand side. According to metric variability as an expression of secondary sexual dimorphism, the large measurements from Dor falling beyond the 8 standard score threshold would indicate rams.

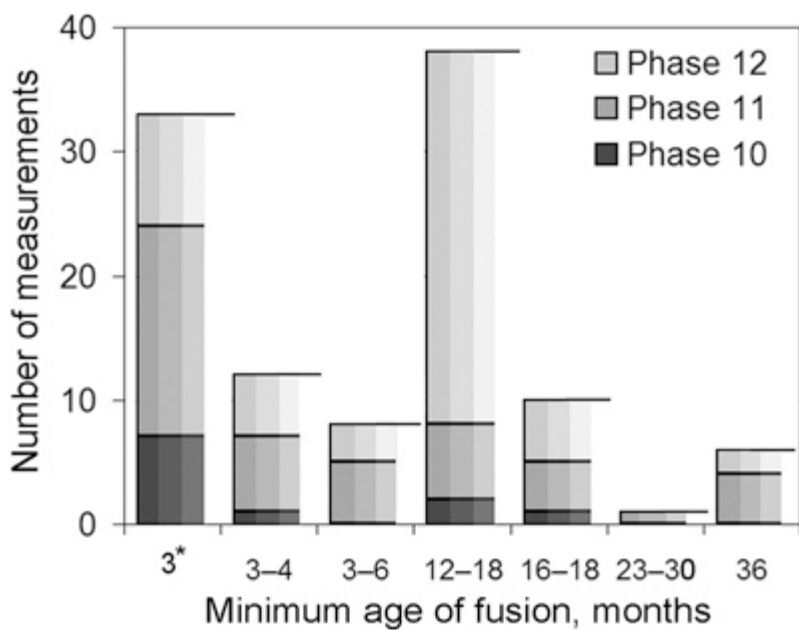


Fig. 15.6. The summary of minimum epiphyseal fusion ages represented in the assemblage of measurable sheep bones from Tel Dor ages. Bone parts already formed by birth (indicated by asterisks in [Table 15.3](#)) were assigned a minimum of three months 'consolidation' time.

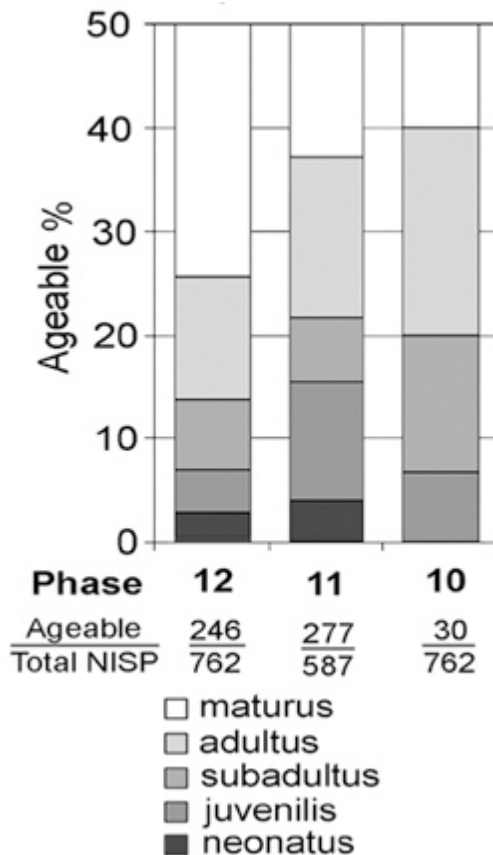


Fig. 15.7. The relative age composition of all ageable caprine bones from Area G at Dor. While the contribution of bones from young animals is only 15–20%, it seems to increase through time.

*Table 15.4. Univariate statistics and Student's *t*-tests showing the possible differences in the average minimum ages represented by the sheep bone measurements available for study*

<i>Parameters</i>		<i>Phase 10</i>	<i>Phase 11</i>	<i>Phase 12</i>
Number of measurements		11	43	54
Mean fusion age, months		6.5	9.7	12.3
95% confidence interval for mean		0.8–12.2	6.8–12.6	9.9–14.7
Standard deviation, months		5.9	10.1	7.3
Maximum, months		17.0	36.0	36.0
Minimum, months		3.0	3.0	3.0
Median, months		3.5	4.5	4.6
Student's t-test		Phase 10	Phase 11	Phase 12
Phase 10	t value		-1.010	
	df		52	
	P value		0.320	
Phase 11	t value			1.470
	df			95
	P value			0.140
Phase 12	t value	2.490		
	df	63		
	P value	0.016		

Finally, the distribution of sheep bone measurements was broken down by phases and plotted into clustered bar graphs, in order to illustrate possible differences between chronological sub-sets (Fig. 15.9).

The visual appraisal of this graph does not suggest significant differences between the three distributions. Virtual curves fitted onto the three groups are summarised in Table 15.5.

Measurements from Phase 10 are underrepresented in the material and can be approximated with a simple equation of the second degree. The low coefficient of determination obtained for this equation, however indicates that nothing special can be stated about this group of bones. Equations of the third degree used in describing materials from Phases 11 and 12 are related to more complex distributions caused by outliers. Slight bimodality, however, is apparent only in the case of the largest, phase 12 sample. Most interestingly, however, all these curves follow the same trend, a form of normal distribution with a slight positive skew towards the few outliers.

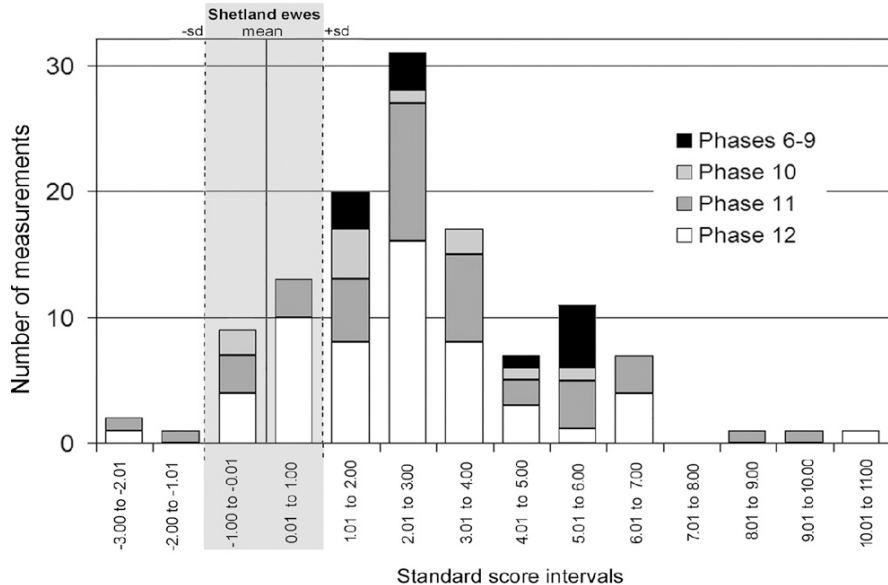


Fig. 15.8. The distribution of sheep bone measurements from Dor by standard scores compared against the parameters of modern Shetland sheep. The continuous vertical line within the grey zone stands for the average measurements of Shetland sheep. Dashed vertical lines mark the distances of ± 1 standard deviation used in the calculations.

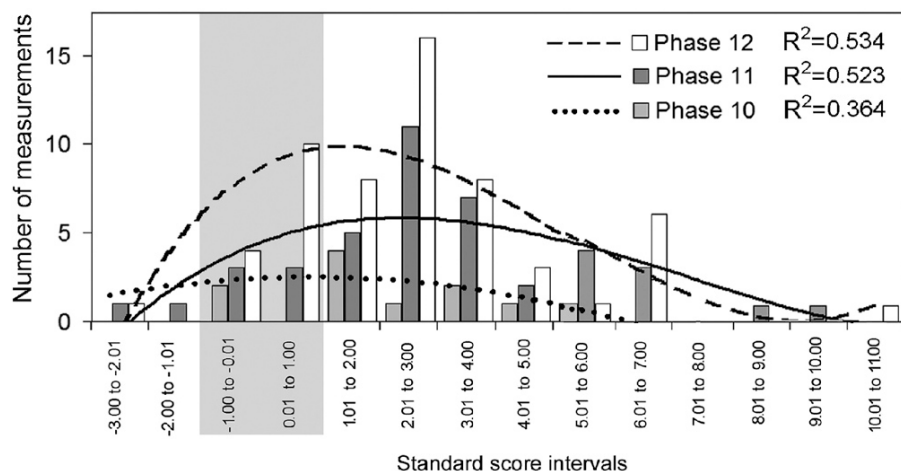


Fig. 15.9. Clustered bar graphs showing possible differences between sheep bone measurements from the three studied phases in Area G at Dor. The curves fitted onto the three types of distributions are detailed in [Table 15.5](#).

Conclusions

Mammalian remains from Area G at Tel Dor show a rather monotonous, slightly increasing contribution of mutton to the diet in

addition to beef. The contribution of caprine bones increases from the Late Bronze toward the Iron Age both in terms of NISP and bone weights. Meanwhile there is an overall trend of killing younger animals with the advancement of historical time.

Table 15.5. Equations describing the curves fitted onto the distributions of bone measurements in [Figure 15.9](#)

	<i>n</i>	<i>Equation</i>	<i>Coefficient of determination</i>
Phase 10	11	$y = -0.0833x^2 + 0.7143x + 0.9762$	$R^2 = 0.364$
Phase 11	43	$y = 0.0138x^3 - 0.4439x^2 + 3.7729x - 3.7989$	$R^2 = 0.523$
Phase 12	54	$y = 0.0404x^3 - 1.068x^2 + 7.588x - 6.689$	$R^2 = 0.534$

A moderate but statistically significant increase of sheep bones relative to those of goats may also be observed at Tel Dor. The opposite of this trend, increasing reliance on nondemanding goats in faunal assemblages in the Near East is known to indicate long-term environmental deterioration (Bökönyi & Bartosiewicz 2000). Sheep, however, must have thrived in the coastal plain. It was hoped that this possibility is mirrored in bone measurements.

The analysis of bone measurements was expected to reflect these tendencies as well:

- There is no detectable age difference between sheep represented in the three early phases at Dor.
- When plotted against the mean values of 26 modern ewes of the Shetland breed, the overwhelming majority of measurements from Dor fell above the Shetland average, and peaked at a ca. +3 sd distance from it.
- Sheep at Dor were thus also understandably larger than Early Neolithic sheep in Hungary.
- Sheep are native to southwest Asia. Therefore, even in ancient times, they grew larger than their brethren in gloomier climates of Europe.
- In contrast to Early Neolithic sheep from Hungary, the standard scores of measurements from Dor show no bimodality, only a few large outliers may be tentatively identified as remains of rams.

The difference between the elements means that different bone

measurements from the three prehistoric subassemblages differ in their deviation from the standard, but this is a consistent trend in all three phases as there is no detectable interaction between phases and skeletal elements. The measurements do not significantly differ among themselves; i.e. the hypothesised diachronic size change could not be detected in the area G assemblage from Tel Dor. To some extent, this may be the consequence of a lack of sufficient numbers of measurements, especially from the latest Phase 10. Visually, the trend lines shown in [Figure 15.9](#) are reminiscent of a whale emerging from the sea. The more seen of the back, the easier it becomes to recognise the animal's real shape. Presumably, female individuals of a relatively large form of sheep were represented throughout the studied Late Bronze and Early Iron Age sections of the stratigraphic sequence. Rarely occurring adult rams at the tail end "surface" only in large assemblages.

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16. New thoughts on the role of the Middle Khabur (Syria) in the urbanisation of northern Mesopotamia during the Early Bronze Age

Scott J. Rufolo

As Mesopotamia is generally regarded as the birthplace of the world's first cities, the archaeology of the ancient Near East has long been framed in terms of the emergence of urban life and state formation. Historically, research has concentrated on the Sumerian city-states that existed in what is now modern Iraq, for it was there, in the southernmost area of the Mesopotamian region, that the earliest indisputable urban settlement systems developed during the late 4th millennium BC. Over the past few decades, however, academic discourse has expanded to include consideration of events in northern Mesopotamia, as archaeological work in northeastern Syria has revealed a similar socio-economic trajectory towards more complex, urbancentred modes of interaction. Although the roots of urbanisation in the north seem to stretch back into the 4th millennium as well, it was only over the course of the subsequent 3rd millennium that states and their attendant cities matured. The Early Bronze Age (3000–2000 BC) witnessed the rapid emergence of sizeable urban centres within the drainage basin of Syria's Khabur River, a phenomenon documented by numerous excavations that have revealed distinct patterns of settlement between the lower and upper portions of the river's course. Several villages were founded along the middle stretch of the Khabur during the first half of the Early Bronze Age and appear to have been engaged in a series of specialised economic activities. The relationship of these communities to the cities that consolidated around pre-existing settlements in the northern steppes of the Khabur Basin by 2500 BC is

uncertain, but it has long been suspected that they played an essential role in the urbanisation process. A discussion of the specific nature of that role is undertaken here in light of new data from a recently completed study of the faunal assemblages from four Middle Khabur sites ('Atij, Gudeda, Raqa'i, Ziyadeh). Specifically, the animal bone evidence is considered with regard to the idea that these settlements supported a specialised pastoralism generating wool for a regional textile industry controlled by urban elites. As large-scale wool production or highly specialised pastoral activity of any kind is not signaled in the faunal data, it is suggested that the participation of the Middle Khabur communities in the urban process was likely of a more subtle and indirect nature.

Keywords Early Bronze Age urbanism, Khabur Basin, Middle Khabur sites, Second Urban Revolution, specialised pastoralism, Tell 'Atij, Tell Gudeda, Tell Raqa'i, Tell Ziyadeh

Prefatory note: This work is based on a paper that was delivered on November 18, 2008 during a session of the 9th ASWA meeting focused on Bronze Age Syria, originally given under the title "New Insights into the 'Second Urban Revolution' of northern Mesopotamia from Five Early Bronze Age Faunal Assemblages of the Khabur Basin, Syria". The intent of that paper was to present a preliminary interpretation of certain sets of data that at the time were in the initial phase of analysis as part of ongoing dissertation research at The Johns Hopkins University. Although the volume containing this published version of the original conference presentation was released some time following the completion of my doctoral programme, the material included here remains largely restricted to the select categories of data and zooarchaeological comparanda examined at the meeting. Specimen counts and species identifications reflect the corrected values recorded in the final dissertation (Rufolo 2011), which may be consulted for a more thorough treatment of the faunal assemblages discussed here, along with the publications presently in press or in preparation that will be derived from it (Rufolo 2015; in press). Citations referencing relevant works from the academic literature published over the past few years have also been added.

Introduction

The ancient Near East has long been a focus of anthropological and historical inquiry into the beginnings of urban society, obtaining a prominent role in the formative period of modern archaeology due in large part to some of the classic early works of Robert McC. Adams

(1956; 1966; 1970; 1972). With the publication of *Heartland of Cities* (Adams 1981), an examination of the nature of initial urbanisation and its concomitant effects on settlement systems and social organisation in Mesopotamia, the topic received its first systematic and detailed treatment making use of a large corpus of archaeological data. This was the product of an intensive survey project whose results enabled the charting of changes in site size, number and location through time, thereby detecting broad patterns of settlement variation on a regional scale. The impact of this seminal study was far-reaching, generating an increasing interest in applying the archaeological record to the question of urban origins through a more rigorous approach. Subsequent research would refine the level of analysis and expand the classes of archaeological data enlisted, soon highlighting the valuable addition that archaeobiological investigation – from both botanical and zoological perspectives – serves in the ongoing academic effort to better understand the development of urban complexes and the rise of state-level society that is intimately related to the emergence of cities (de France 2009; Redding 1992; Rosen 1999; 2007; Zeder 1991).

In contrast to the small-scale settlements and sparsely populated nature of the pre-urban period that preceded its appearance, the urban environment is defined in part by a concentration of human population into larger towns and cities whose relationship with the surrounding countryside would come to be framed within a social system based on an urban-rural dichotomy (Crumley 1976; Marcus & Sabloff 2008). This process entailed changes in political and economic organisation to accommodate the greater scale of activity and density of settlement, factors that placed new demands on communities in terms of securing and distributing adequate supplies of essentials such as foodstuffs and raw materials for manufacture. Expanding and intensifying agricultural practice was often a key response to meet these new challenges, therefore archaeobotanical and zooarchaeological research endeavors equally hold the potential to open important avenues of research concerning the development and mechanics of early urbanism. Faunal studies in particular have centred on pastoralism as a primary component of the urban process, ancient sources as well as modern ethnography both highlighting the important role of pastoral nomadic groups in conditioning urban development throughout the history of the Near East (Adas 2001; Fabietti & Salzman 1996; Matthews, 1978; Schwartz 1995; Zagarell 1989; Zeder 1999). Considering the environmental and cultural context of ancient Mesopotamia, only a mobile lifestyle could afford certain animal products in sufficient quantity to meet the increasing

subsistence demands of nascent city-based populations. Pastoral production would have both fueled population growth and provided a basis for political control as exercised through directing the flow of pastoral goods into sedentary sectors of society, particularly those of urban affiliation. Thus, the administration of goods derived from herded animals, and even the management of the herders themselves, constituted one of the arenas for the development of the more complex levels of authority, societal regulation, and economic exchange that characterise urban systems and state-level political organisation. In terms of archaeology, this translates into the potential to detect the specialised economic structure considered indicative of the state through documenting a rural economy that is anchored in a focused pastoral activity – one tailored to maximise meat yield, dairy production or wool generation beyond the immediate needs of the community –and thus integrated into a regional, urbanbased market.

For those who study the early history of the Middle East, the capacity to identify evidence of the primary social constructs of the state/urban complex in the archaeological record has long been of great interest. The Sumerian city-states of southern Mesopotamia represent the first expression of urban social organisation on a significant scale in the ancient Near East, likely the world, and as such understanding their origins is a central concern of the archaeology of the region. The immediate socio-cultural foundations of these cities rest in the early to mid-4th millennium BC (Pollock 2001) with the growth of large population centers such as those at Nippur, Lagash, Uruk, Larsa, and Ur (Fig. 16.1). By 2800 BC, the scale and nature of this urbanisation in the Sumerian heartland, along with its associated political effects, had achieved a larger and more complex character (Huot *et al.* 1990; Stone 1995), soon to be accompanied by a florescence of urban systems that first appeared in adjacent regions during the second quarter of the 3rd millennium BC. This subsequent socio cultural phenomenon of the Early Bronze Age (3000–2000 BC) unfolded primarily in what is now northern Syria, south-central Turkey, and northwestern Iraq, becoming in the past few decades the subject of a considerable level of archaeological scrutiny regarding the urban process, state formation, and the evolution of complex social networks (e.g., Weiss 1986; Wilkinson & Tucker 1995; Cooper 2006; Wattenmaker 2009). An early examination of the role of pastoralism and general subsistence economy in the urban core of Mesopotamia during this period of expanding urbanism is present in Mudar (1982), which employs faunal data from the Iraqi site of Tell al-Hiba, ancient Lagash, to profile animal use during the Early Dynastic III phase of

that city (ca. 2600–2350 BC). Mudar’s study considers a period of mature urbanisation in southern Mesopotamia, and later zooarchaeological work shifted the focus to contemporary peripheral areas that were experiencing earlier, less advanced stages of urban development. Notably, Stein and Wattenmaker (Stein 1987; Wattenmaker 1987; Wattenmaker & Stein 1986) investigated the strategies of animal management in rural communities of southern Anatolia during the Early Bronze Age.

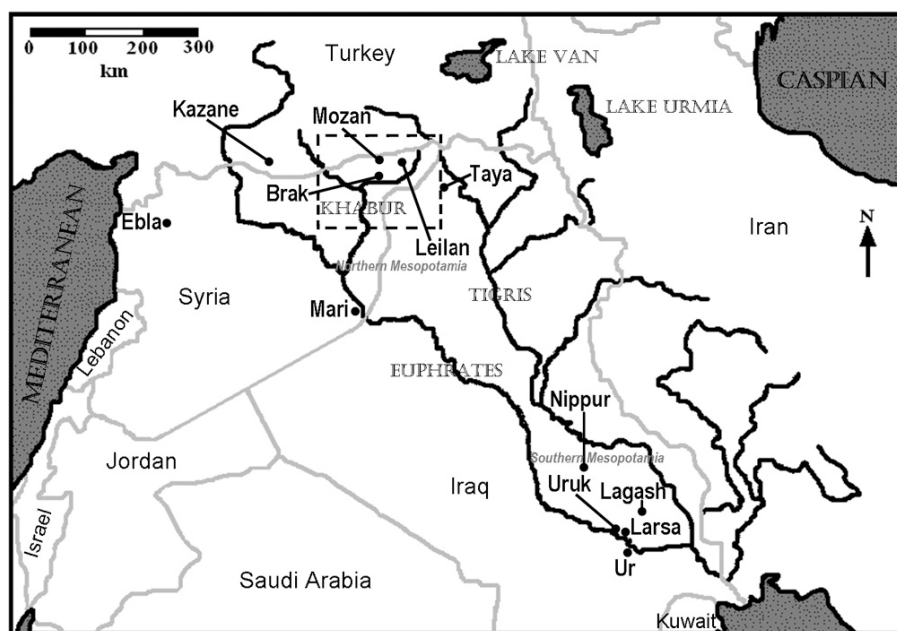


Fig. 16.1. Map of the Near East indicating the location of several sites mentioned in the text, those of the Middle Khabur region shown in [Figure 16.2](#), which corresponds to the area enclosed in a broken-line square on this figure.

These prior articles explored the extent to which pastoralism contributed to urban structures and in what manner animal-based economic relationships may have influenced urban development, from a rural perspective in the case of the Anatolian sites and an urban setting in the Iraqi example. Simultaneously, similar zooarchaeological research concerning 4th–2nd millennium remains from the Iranian urban center of Tal-e Malyan (Zeder 1984; 1988) also highlighted the valuable insights derived from faunal analysis concerning the sociocultural factors essential to the ancient urban process, culminating in a detailed consideration of the importance of

specialised pastoralism to the creation and evolution of the ancient Near Eastern city (Zeder 1991). Building upon this foundational scholarship, an additional body of zooarchaeological information for Mesopotamia has been assembled as a component of the Program in Human Ecology and Archaeobiology based at the Smithsonian Institution's National Museum of Natural History. This recently completed research involves the animal remains from five Early Bronze Age sites of the Khabur Basin of northeastern Syria and was designed to expand the range of archaeological material available for assessing urban emergence and socioeconomic structure during the formative phases of city life and state-level society in Mesopotamia, primarily through providing detailed data from the heart of northern Mesopotamia representing associated sites of both the rural and urban sectors dating to the period of initial full-scale urbanisation in this region. In this, the first publication resulting from this work, the general goals of the project are introduced and certain data sets are presented in order to broadly address the role of pastoralism in the ancient urbanisation of northern Mesopotamia through considering the zooarchaeological evidence for a specific activity that has been suggested in the academic literature to have been an important factor: wool production.

The Khabur Basin and the urbanisation of northern Mesopotamia

The Second Urban Revolution

The pattern of urbanisation in ancient Syria is a particularly interesting case as the Khabur Basin is at the geographic core of a string of urban centers that developed over the course of the 3rd Millennium BC, the appearance of which has been termed the 'second urban revolution' (Akkermans & Schwartz 2003, 233; Mazzoni 1991). These settlements ultimately represent the first stable manifestation in northern Mesopotamia of political states, traditionally regarded in anthropology as the highest level of social complexity, forming several centuries after the crystallisation of urban networks and the rise of the city-state in southern Mesopotamia, but by the latter half of the Early Bronze Age clearly serving as the nuclei of populations embedded in state-level constructs. Modelling the rise of the earliest states occupied a noteworthy portion of the anthropological and archaeological research of the 20th century (Lewis 1983; Yoffee 2005), and the apogee of complex society is still viewed to be the state and its

frequently attendant network of urbanised settlement structures. Simply put, state-level society, characterised by highly differentiated systems of centralised administration, social stratification and economic specialisation, represents the most intricate form of social order (Mann 2003; Wright 1977; 1978; Zeder 1991, 2–18). The nation-state is undoubtedly the most ubiquitous and influential form of social organisation in the modern world, and scholarship therefore continues to recognise the distinct import of the state and its complexities. There is a growing appreciation, however, of the fact that its origin, and relationship with other forms of social order such as the chiefdom, is not a clear-cut matter of orthogenetic progression from simple to complex (Feinman 2008; Gailey & Patterson 1988; Trigger 1998; Yoffee 2005). The proximity in both time and space of the urbanisation of the Khabur Basin in relation to that of the surrounding regions, particularly southern Mesopotamia, affords an intriguing opportunity to explore the nature and variability of the early state in the ancient Near East.

The Early Bronze Age cities of Syria emerged around 2600 BC and flourished until the end of the 3rd millennium, forming the central component of an arc of nascent urban systems that stretched from Ebla in the west through northern Syria and into neighbouring regions with sites such as Kazane Höyük in Turkey and Tell Taya in Iraq (Pfälzner 1997; Wattenmaker 1998, 19–27; Weiss 1986, 83–87). The preceding centuries of the early 3rd millennium in Syria lacked the hallmarks of urban society and represent an apparent arrest in the development of greater social complexity that was evident in the 4th millennium during what has been called the Uruk Expansion (Akkermans & Schwartz 2003, 211–232). This term refers to the well-documented appearance during the mid–late 4th millennium BC, equivalent to the Uruk Period of southern Mesopotamia, of Sumerian-style material culture and what have been described as southern colonial enclaves across northern Mesopotamia (Algaze 1993; Schwartz 2001). Syrian communities therefore experienced the initial developments of more complex, urban-oriented social organisation under the influence of the newly formulated Uruk states, but did not continue along this path in the opening centuries of the Early Bronze Age. The full-fledged urbanisation that materialised later in the Early Bronze period thus represents the reappearance and maturation of a process that had first established itself centuries before, resulting in the denomination of Syria's urban revolution as 'secondary' both relative to the earlier urbanisation of the Sumerian heartland and to Syria's own history of social evolution (Akkermans & Schwartz 2003,

233). Considering this interrupted social trajectory, understanding the nature of state-formation and urban genesis provided by the Syrian case requires a careful exploration of both the urban system of the later Early Bronze Age and the pre-urban situation from which it developed. The Khabur Basin, thanks to both its location and history of intensive archaeological excavation, proves the ideal case study for accomplishing this.

Early Bronze Age archaeology of the Khabur Basin

The Khabur River (Fig. 16.2) is a tributary of the Euphrates and runs through the Syrian portion of the Jazirah, the steppeland of northern Mesopotamia that extends from the Euphrates eastward into northwestern Iraq. The upper reaches of the Khabur lie within the better-watered northern region of the river's drainage basin, where annual rainfall is generally sufficient to permit dry farming on a large scale (Weiss 1986,71–82). In contrast, the Khabur's middle and lower stretches fall below the 250mm isohyet, the meteorological divide that separates the wetter north (which receives greater than 250mm of precipitation on average in a year) from the semi-arid steppe of the south whose grasslands today experience too little rainfall to support agricultural endeavors of a significant degree without irrigation (USDA 1980). During the latter half of the 20th century, excavation of Early Bronze Age settlements of the northern basin, such as those of Tell Mozan, Tell Brak, and Tell Leilan, signaled this region's participation in the second urban revolution through detecting the presence of cities of considerable size possessing an urbanised network of satellite communities (Stein & Wattenmaker 1990; 2003; Ristvet 2005). Archaeological work conducted further to the south along the banks of the Middle Khabur revealed a cluster of early–mid-3rd millennium BC sites whose locational propinquity to the northern urban centres, occupation during the initial Early Bronze pre-urban period, and evidence of specialised economic activities generated an intense amount of interest in their potential role in the urbanisation of the Khabur Basin (Akkermans & Schwartz 2003, 218–224; Fortin 1998b; Schwartz 1994b).

In the regional chronology for northern Mesopotamia (the most thorough treatment of which is provided by Lebeau 2011), the pre-urban phase of the Early Bronze Age corresponds with the Ninevite 5 period, dated to around 3100–2550 BC (Weiss *et al.* 1993; Matthews 2000) and named after the distinctive set of painted and incised pottery styles first identified in level 5 of the excavations at Nineveh in Iraq (Mallowan 1964). Sites associated with the Ninevite 5 culture,

which covered northwestern Iraq and the eastern portion of the upper Khabur Basin (Rova 2003; 2011), may not attest to a continuation of the urban patterns of late 4th millennium Syria, but they have yielded signs of certain features of social complexity, such as a two-tier settlement hierarchy, the use of cylinder seals and numerical tablets, the construction of small temples or shrines, and evidence of social rank in the form of differential burial practices (Schwartz 1986; 2000; Fortin 2000). Additionally, the sites of the Middle Khabur region – which fall on the periphery of the Ninevite 5 cultural sphere and formed a distinct ceramic province influenced by Ninevite 5 as well as other stylistic traditions (Lebeau 2000; Rova 2000) – record the presence of large-scale storage structures and a significant degree of economic specialisation. A survey conducted in 1983 in advance of the flooding expected along the middle Khabur River following completion of a new dam to the south identified 22 sites that were likely occupied during the first half of the 3rd millennium (Monchambert 1983; 1984), 15 of which have been the subject of systematic excavation yielding Ninevite 5 remains to one degree or another (Fortin 1998b, 22; Rufolo 2011, 125–156). These sites are not large, ranging from less than a hectare in size up to 6ha, and it has been demonstrated that a significant number were founded during the opening centuries of the Early Bronze period (Akkermans & Schwartz 2003, 218). Despite their small size, evidence of economic specialisation is plentiful. Several sites are dominated by sizeable and numerous silos and granaries, storage bins, and ‘industrial’ processing areas. By the opening of the second half of the 3rd millennium, these communities appear to have been largely abandoned. The substantial and coherent corpus of data provided by the Middle Khabur excavations indicates a sophisticated, if pre-urban, degree of socio-economic complexity (Fortin 1999; Forest 2003). In light of archaeological scholarship that makes clear the important links between craft specialisation, villagebased economic production and the growth of early cities (Hayden 1994; Stein 1996; Wattenmaker 1998; Henrich & Boyd 2008), the discoveries along the middle course of the Khabur occasioned extensive academic discourse that attempts to identify precisely why so many specialised settlements would appear in an environmentally marginal region that previously held few permanent habitations.

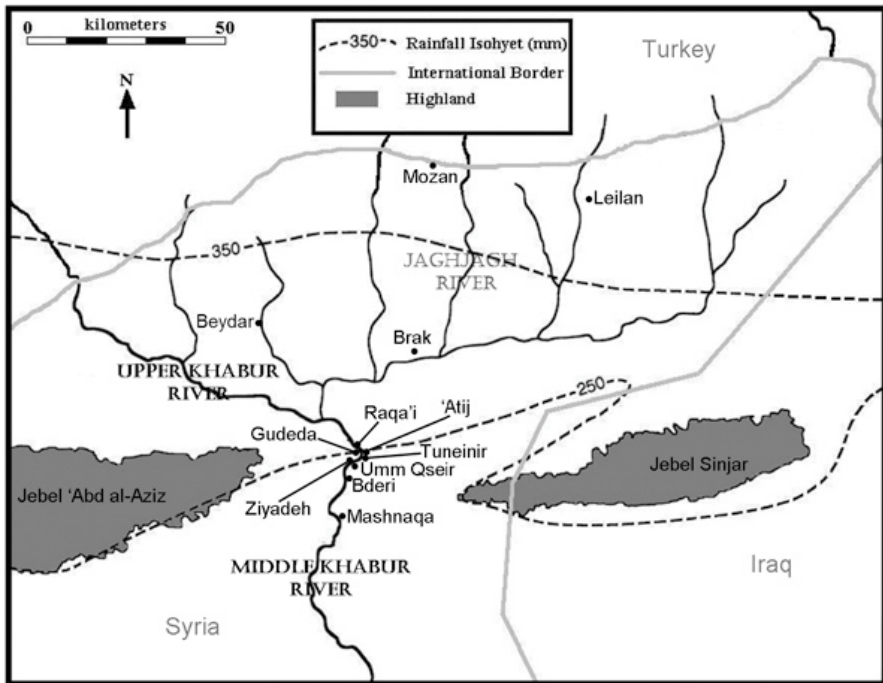


Fig. 16.2. Map of the northern and central portions of the Khabur Basin, a closer view of the boxed area present in Figure 16.1, showing the archaeological sites of this region discussed in the text and cited in Figure 16.3.

The establishment of the early 3rd millennium villages in the central portion of the Khabur Basin is generally linked with developing urbanism in a series of models that have been proposed to account for the concentration of Middle Khabur sites and their specialised nature (Akkermans & Schwartz 2003, 221–223; Fortin & Schwartz 2003, 224–226; Zeder 2003, 170–172). In very broad terms, these models are based in one of two theoretical frameworks concerning the primary stimulus that initialised the Early Bronze Age changes within the central Khabur Basin: socioeconomic restructuring due to direct political pressures and opportunities for trade presented by urban populations outside of the Middle Khabur (e.g. Curvers & Schwartz 1990; Fortin 1997; 1998a; Margueron 1991; McCorriston 1995; 1997; 1998; Schwartz 1994a; 1994b) or an internal, indigenous urban-oriented evolution driven principally by localised factors that operated in a fashion largely independent of external developments or under limited influence by them (e.g. Hole 1991; 1999; Kouchoukos 1998, 410; Kulemann-Ossen 2002; Zeder 2003; Porter 2012). This dichotomy between an internal genesis and an externally driven origin

for the sociocultural developments behind the settling of the Middle Khabur is merely a convenient heuristic for capturing the central social forces envisioned in the various explanatory models as being the key instigators of change in settlement pattern and thereby organising them for consideration. Of the specific scenarios offered in the literature, most acknowledge the likelihood that the past social situation was a complex interplay of factors and processes that were not necessarily mutually exclusive at all time, but each does place a differing emphasis upon the continuing role of local versus external influences once social transformation has begun.

Much of the discussion concerning the Middle Khabur sites is centred on a limited number of potential socioeconomic arrangements that would have defined the functional relationships of these villages with one another and also with the neighbouring territories undergoing urbanisation. One of the most fully articulated scenarios was established through a focus on the archaeological features and artefact inventory documented for the site of Tell 'Atij (Fortin 1997; 1998a; 2001), becoming the primary representative of those models that favour an external driving force behind the Early Bronze Age settlement of the central length of the Khabur River. In this view, the express organisation and control of the Middle Khabur sites was undertaken by foreign elites from a southern city, likely Mari, which was entrenched more deeply in the older and further developed urban culture of southern Mesopotamia on whose periphery it sat. Alternatively, management of the sites may have been conducted directly or indirectly from powers based within the Khabur Basin itself through exploitation of the southern stretches of the river by consolidating polities of the Upper Khabur drainage area in an as-yet undetermined fashion (Weiss 1990, 214–215). Rather than a concerted colonisation effort, both of these scenarios see the inhabitants of the specialised villages coming primarily from local semi-nomadic groups, a certain proportion of whose members settled along the river to engage in economic activity ultimately directed by outside officials. Some of these officials were likely resident at the villages, but the Middle Khabur was not incorporated politically into a nearby territory. The villages nonetheless are understood to be manifestations of the developing urbanism in northern Mesopotamia, existing to service urban economic demands for agricultural products such as grain and wool.

Several competing interpretations soon arose, challenging the notion that foreign authorities had such a direct influence. Rather than resting under the express political purview of larger

communities, either local or foreign, these small sites could also represent opportunistic settlement of the Middle Khabur by semi-nomadic peoples of the nearby steppe to benefit from riverine trade conducted between the urban communities emerging to the north and south (Curvers & Schwartz 1990, 22; Margueron 2000). Focusing on the material uncovered at Tell Raqa'i, Curvers and Schwartz (1990; Schwartz 1994b; Schwartz & Curvers 1992) argue that small-scale chiefdoms may have evolved along the river as local tribal leaders found opportunity to consolidate power and wealth through emulating the rulers of the emerging cities and controlling water-borne commerce. Another possibility is to understand the clustering of settlements at and just below the 250mm isohyet as an indicator of localised interaction with mobile pastoralist populations of the surrounding steppe, also an opportunistic situation but one that principally took advantage of trade with nomads and thus had little relation to subsequent urbanisation (Hole 1991; 1999). On the other hand, such native economic specialisation focused along the Middle Khabur – regardless of its economic focus in terms of primary trading partners and possibly initially triggered by a brief period of higher rainfall in the Middle East that made the central lands of the basin more attractive in terms of agriculture (Avner 1998; Bar-Matthews *et al.* 1998; Hole 1997) – may have actually *provided* the initial force leading to the expansion of urban society in the Khabur Basin or at the very least enabled the socio-economic structures that supported that expansion. Previous archaeobiological investigations concerning the area tend to favor this last idea to varying degrees, albeit from vantage points situated within one or the other of the two overarching conceptual frameworks (predominant external influence versus largely internal development). The discussion will now turn to these early studies of the floral and faunal assemblages from the Middle Khabur sites, as the research project described in this chapter represents the next step in the zooarchaeological component of these works.

Archaeobiological interpretations of the Middle Khabur phenomenon

Both archaeobotanical and zooarchaeological treatments have contributed to the archaeological debate surrounding the sudden appearance and relatively brief occupation of the Early Bronze Age Middle Khabur sites, presenting particular scenarios distilled from the general explanatory paradigms previously developed in the literature as overviewed in the previous section. The botanical material recovered from several Middle Khabur excavations indicates that

barley, a preferred crop for foddering animals, was the primary grain processed and stored in the granaries (McCorrison 1995; 1998). In fact, debris from the threshing of barley increases dramatically over the course of the early 3rd millennium BC (McCorrison & Weisberg 2002; McCorrison 1998). In addition, remains from steppe plants also become more numerous in the later deposits of these sites, signaling an increasing utilisation of the surrounding plains to support herds of sheep and goat. This has been interpreted as an intensification of pastoral production to provide wool for an expanding trade in textiles (McCorrison 1997), which we know from textual evidence to have been a chief commodity in the ancient Near East whose production was regulated by urban authorities. A burgeoning textile industry centred in urbanising areas to the north and/or south may have therefore drawn the Middle Khabur into a developing statelevel economy, the potential import of a growing demand for wool in determining the socio-economic orientation of the Khabur Basin having been noted by others as well (Buccellati 1990; Hole 2007a, 198; Margueron 1991). Fortin (2001, 43), citing the identification of *Carthamus tinctorius* (safflower) among the botanical remains from the site of 'Atij (McCorrison 1998), also suggests that wool processing may have been a significant function of the Middle Khabur settlements. The flower of this plant is used to create a red dye for colouring woollen and other textiles, and basalt grinding stones from 'Atij may preserve the remnants of dye extraction (Fortin 2000, 43).

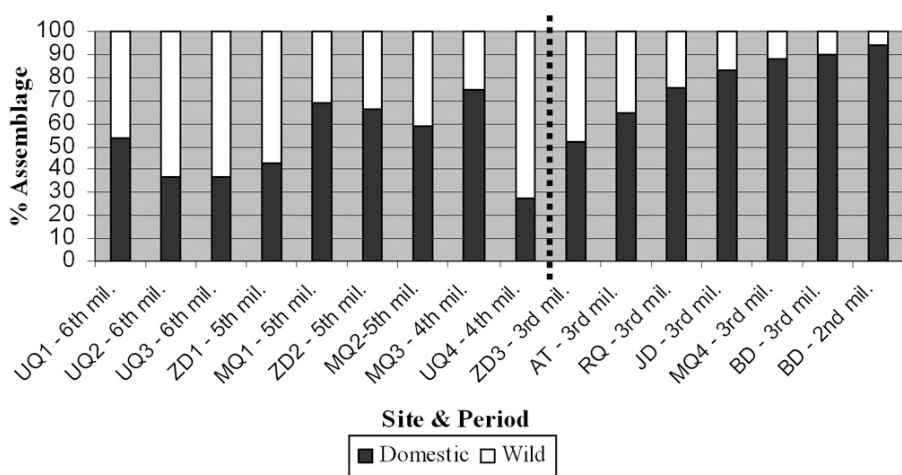


Fig. 16.3. Graph of domestic vs wild species for sites of the central Khabur Basin from the 6th–2nd millennium BC according to data presented in Zeder (1998a). Sites are plotted along the x-axis in chronological order (their geographic locations shown in Fig. 16.2) with the oldest on the left, the y-axis indicating the percentages of domestic and wild taxa for the total

identified assemblage for each site. The dotted vertical line separates the Early Bronze Age sites to the right from those of earlier periods to the left, highlighting the trend of increasing utilisation of domesticated species from the late 4th millennium onward. Site abbreviations: AT = 'Atij, BD = Bderi, JD = Gudedu, MQ = Mashnaqa, RQ = Raqa'i, UQ = Umm Qseir, ZD = Ziyadeh.

In an effort to provide an elementary profile of the animal economy of northern Mesopotamia from the 8th to the 2nd millennium BC, the animal remains from a number of sites located in the Khabur Basin have already been analysed in a preliminary fashion (Zeder 1995; 1998a; 1998b). The results indicate an increasing reliance upon domesticates, particularly caprines, from the later 4th into the middle 3rd millennium (Fig. 16.3). This coincides with the onset and maturation of urbanisation in the basin, indicating a shift in subsistence focus that is likely related to this process. Such a transformation from a diversified strategy balancing both wild and domestic resources to an almost exclusive focus on sheep and goat complements the archaeobotanical data, an elevated occurrence of caprines supporting the notion of expanding pastoral activity. This is viewed as an internal development, however, as the faunal data evidence a gradual transformation of local practices rather than the sudden intensification or dramatic reorientation of pastoral activity that one might expect if economic demands from populations outside the basin were directly or indirectly imposed (Zeder 1998a, 64–65). In further support of an unbroken local trajectory, Zeder (2003, 174–175) contends that the more focused pastoral activity along the Middle Khabur during the second quarter of the 3rd millennium is likely the precursor of the pastoral specialisation evidenced at the site of Tell Tuneinir during the second half of the Early Bronze Age. Excavation of this Middle Khabur site uncovered remains of an Early Bronze occupation dating to between 2500 and 2200 BC (Fuller & Fuller 1998), the period following collapse of the Middle Khabur settlement system, and thus Tuneinir represents one of the few communities that continued to inhabit this stretch of the river in a sedentary manner following the rise of the Upper Khabur cities. A zooarchaeological analysis of the Early Bronze Age faunal material from Tuneinir documented a strong emphasis on sheep and goat husbandry as well as a delayed culling pattern (Loyet 1994; 2003), an increased kill-off of older animals being expected if adult sheep were maintained until their ability to produce good quality wool wanes. These data, as well as the fact that artefacts associated with wool

production have been recovered from Tuneinir and also from urban centres of the northern part of the Khabur Basin (one of which, Tell Beydar, has additionally yielded textual evidence (Sallaberger 1996; 2004; Van Lerberghe 1996) for the centralised management of sheep herds and the production of wool), strongly suggest that a wool-based economy was active at some level in the area during the latter half of the 3rd millennium BC. The extent to which wool extraction and preparation was carried out, if at all, during the preceding centuries of the millennium, however, remains uncertain.

To better address the issue of wool production, as well as the more general questions surrounding the nature of the Middle Khabur sites and the mechanics of the Second Urban Revolution, a more detailed examination of a number of Early Bronze Age faunal assemblages from the Khabur Basin was undertaken with the intent of furnishing greater resolution concerning the details of the animal-based economic activity conducted along the Middle Khabur. As specialised economic pursuits and large-scale production are essential elements for the development of the state and for supporting urban systems, identifying further evidence for the management of sheep and goats to generate surplus goods – be it wool, meat or dairy products – would contribute significantly to the discussion concerning the urbanisation of the Khabur Basin. As an introductory effort to this end, an arrow set of initial results, are communicated in this work concerning the faunal assemblages from four sites to expressly evaluate the evidence for wool production. Even if limited, these opening comments provide valuable zooarchaeological details that were previously missing for the Early Bronze Age settlements of the Middle Khabur region (Zeder 1998a, 66; although see Vila 2005 for a comparably detailed analysis of a single, comparatively smaller animal bone assemblage from the Middle Khabur site of Tell Kneidig), and though tailored to a particular matter and locale – the proposed involvement of wool as an important commodity in the Khabur Basin during the first part of the Early Bronze Age – the relevance is potentially more wide-ranging as it is widely regarded that wool in general was an essential element of the broader ancient Mesopotamian economy from the 3rd millennium BC onward (Crawford 1973; Jacobson 1970; McCorriston 1997, 518). This is intended to be the first in a series of works that will explore various aspects of the Middle Khabur faunal material examined by the author, considered in comparison with the growing corpus of Early Bronze Age zooarchaeological data available for the entire Khabur Basin, with the goal of augmenting our understanding of the interplay between intensified pastoralism, economic specialisation, and

hierarchical social relations as defining elements of the heightened social complexity that spawned the Second Urban Revolution.

Zooarchaeological analysis

The Smithsonian Khabur Basin Project and site descriptions The Khabur Basin initiative, a research scheme of the Program in Human Ecology and Archaeobiology (PHEA) of the National Museum of Natural History (NMNH), Smithsonian Institution, was developed in association with the Khabur Basin Project of Yale University (Hole 2007b). A significant asset of the collections of Syrian zooarchaeological remains maintained by the NMNH is that they present a sufficiently broad temporal and geographic range, one that enables a proper consideration of the uncertainties that remain regarding the transition to urbanism in the Khabur Basin from a deep chronological perspective. The Archaeobiology Program of the PHEA curates faunal assemblages obtained from thirteen Khabur Basin sites, moreover receiving permission to analyse animal remains from two additional excavation projects that house their zooarchaeological finds elsewhere, so the material examined as part of the Smithsonian Khabur Basin Project represents occupations that date to as early as the 8th millennium BC up to the 2nd millennium (Fig. 16.3). Focusing on the Early Bronze Age, the final phase of the PHEA research agenda centred on the Khabur Basin – represented by the work detailed here – involves the faunal assemblages of five sites whose deposits span the 3rd millennium BC and that represent both the southern and northern components of the Khabur's drainage system. Earlier work with the faunal material from these five excavations produced a baseline set of zooarchaeological data such as coarse taxonomic identification and general counts and weights, the first stage of a two-part analytical regime developed for processing large faunal samples quickly and efficiently (Zeder 1990, 24–25). The second stage of this procedure, which consists of reexamination of a select set of specimens drawn from stratigraphically controlled loci to capture a suite of osteological information containing over 20 categories of information for each specimen, has now been concluded. As previously mentioned, this more rigorous analysis provides greater archaeological resolution concerning the initial urban development of the Khabur Basin and its relationship with the subsistence economy. Beyond this regional episode of urbanisation, the new data caps the millennia-spanning zooarchaeological survey of this area compiled during the early phases of the Smithsonian Khabur Basin Project with a level of detail that permits some broader statements regarding the course of sociocultural

evolution in northern Mesopotamia and the patterns of social complexity in the ancient Near East during periods of urban emergence and early state formation.

Four of the sites – Tell ‘Atij, Tell Gueda, Tell Raqa’i, and Tell Ziyadeh – dotted the banks of the middle course of the Khabur south of its confluence with the Jaghjagh River (Fig. 16.2), but are now submerged beneath the water retained by a dam completed in 1996 further to the south. Both ‘Atij and Raqa’i yielded large storage structures, notably numerous and often sizeable silos for holding grain, and areas dedicated to processing activities (Fortin 1991a; 1993; 1995; Curvers & Schwartz 1990). The excavator of ‘Atij, based in part on geomorphological evidence (Blackburn & Fortin 1994), maintains that the site was an island in the river at the time of occupation and, as he identifies no clearly domestic structures among the uncovered architectural remains, interprets the settlement as a dedicated manufacturing and trade depot in use from 2750–2400 BC (Fortin 1998a, but see Pfälzner 2001, 310–312 for an argument that single-room houses are indeed present and Quenet 2011, 33 for dating the earliest levels of ‘Atij to around 2900 BC). In addition to storage and processing installations, concentrated most notably in a large rounded structure central to the site, excavations at Raqa’i uncovered remnants of residential quarters as well as a small shrine or temple (Curvers & Schwartz 1990; Schwartz & Curvers 1992). Occupation levels at Raqa’i date to between 2850 and 2500 BC. Gueda, situated between ‘Atij and Raqa’i on the opposite bank of the river, was a compact settlement also apparently lacking domestic architecture and seemingly devoted entirely to craft manufacture (Fortin 1991b; Routledge 1998). Gueda was likely founded near the end of the Ninevite 5 period, perhaps around 2650 BC, and remained in use into the latter half of the millennium, perhaps even as late as 2300 BC. Exposure of Early Bronze Age remains (dating to 2900–2750 BC) on Ziyadeh – a site which yielded a much more extensive set of 5th millennium BC architectural units – was restricted to a small area containing a single coherent structure, whose configuration and associated features indicate that it served a specialised function for storing an unidentified good or range of products (Hole 1999). All four of these sites are less than a hectare in size and each is awaiting publication of the final, comprehensive excavation report that will definitively document their stratigraphy and findings.

The fifth Early Bronze Age assemblage included in the latest phase of study of the Smithsonian Khabur Basin Project is that of Tell Leilan, a much larger site located in the better-watered northern belt of the

Khabur Basin along one of the Khabur River's tributary channels (Weiss 1983; 1990; Weiss *et al.* 1990). As one of the cities attesting to the urban system present in the Upper Khabur area by the second half of the Early Bronze Age, Leilan possesses a longer history of occupation in comparison with the other four sites and has yielded extensive middle to late 3rd millennium BC architectural remains of both an upper and lower town. Analysis of the Leilan data has not yet progressed to a sufficiently advanced stage to allow for its discussion here. Over 70% of the Early Bronze Age faunal material from Leilan that was prioritised for the second-stage analysis belongs to the latter half of this period (2500–2200 BC) and therefore largely postdates the primary occupational phases of the Middle Khabur sites (2800–2400 BC) whose increasing focus on herding during the earlier 3rd millennium is of present concern. Of the oldest Early Bronze Age Leilan remains, which number fewer than 2300 specimens in total from secure contexts, over 93% date to the Leilan IIId phase (2650–2500 BC), the period during which Tell Leilan evidences the earliest signs of urban organisation and state formation (Ristvet 2005, 57–61) and a time by which many of the Middle Khabur settlements were beginning to experience declining populations and a reduced emphasis on large-scale grain storage (Akkermans & Schwartz 2003, 262; Hole 1999, 280). The relatively small number and chronologically-weighted nature of the pre-2500 BC Leilan faunal specimens thus limit their comparative value for the purposes of this work, but once analysis of the data is complete, the Leilan remains will undoubtedly refine the interpretations presented here and provide the complementary urban perspective that is necessary for understanding the relationship between the north and south of the basin during the Early Bronze Age but particularly for the crucial mid-millennium period of urban consolidation.

Taphonomic concerns

Over 22,000 faunal specimens were recovered from the Early Bronze Age deposits of the four Middle Khabur sites discussed here and processed at the Zooarchaeology Laboratory of the Smithsonian Institution (Table 16.1). Of these, 18,539 representing more than 80% of the total recovered count, were subjected to detailed examination following their selection based on association with secure archaeological contexts. With over 9,000 analysed specimens, the Raka'i assemblage is the largest, far greater than the 706 bone fragments recorded for Ziyadeh. Multiple levels of Early Bronze Age occupations were identified at 'Atij, Gudedā, and Raka'i, however only

a single operation of the Ziyadeh excavation produced animal remains reliably dated to a 3rd millennium context but one lacking sufficient exposure to permit recognition of successive levels. The faunal material from all the sites is treated here as four individual aggregate assemblages, those from multi-level excavations combining specimens from all Early Bronze Age levels identified for the respective sites. This is necessary to permit general comparison, as only in the case of Raka'i is there a large enough sample of sheep and goat remains to construct meaningful culling profiles on a level by level basis. A site-level analysis is adequate for the detection of wool production on a significant scale, however, as signals of specialised pastoral activity should be present even at this coarse level of examination if such specialisation was practiced as a component of a regional wool industry. Although it is unrealistic to expect the tightly focused strategies for maximising wool yield that are evident for herders of later periods when welldeveloped market economies are in place and specific wool-bearing types with a long history of selective breeding are available, it is possible to evaluate the suggestion that a primary economic function of the Middle Khabur sites was to supply burgeoning cities with raw material for textile production using the zooarchaeological data. If a system for the generation of wool beyond the general needs of the settlement was in place, the recovered animal bones will indicate a strong emphasis on raising sheep as opposed to goats, accompanied by signs of ovine management suited to procuring the animal's fleece in fairly large quantities. This pattern should be evident for all the sites in order to lend credence to the idea that an integrated, regional economic network crystallised as part of the urbanisation process.

Table 16.1. Number of faunal remains recovered from Early Bronze Age deposits of the Middle Khabur sites discussed in the text. The 2nd column provides the total number of specimens recovered during excavation and stored at the Smithsonian Institution. The number of skeletal elements and bone fragments from these totals assigned to secure archaeological contexts and therefore selected for second-stage analysis is given in the 3rd column, followed by the percentage of the recovered total represented by these prioritised sets shown in the 4th.

<i>Site</i>	<i>No. recovered specimens</i>	<i>No. analysed specimens</i>	<i>% recovered specimens</i>
'Atij	7870	6395	81.3
Gudeda	3289	1996	60.7
Raq'a'i	10,852	9442	87.0
Ziyadeh	712	706	99.2
Total	22,723	18,539	81.6

In terms of the general taphonomy, over 90% of specimens recovered from 'Atij, Raq'a'i, and Ziyadeh were removed from general refuse deposits, although no true middens or distinct trash heaps or pits of any significant size were recorded. As is typical for Middle Eastern sites, most of the assemblage for these three sites accrued as general deposition in areas of the community that were not dedicated to specific activities but which were adjacent to inhabited spaces and therefore convenient for receiving daily household waste, such as abandoned buildings and little-used open areas between structures. In the case of Gudeda, a much smaller proportion of the sample (50%) represents these general discard deposits. Most of the remaining half comes from contexts that have been coded as primary accumulation, material identified by the excavators as resting immediately above floors and occupation surfaces. These may represent nothing other than the initial deposits amassed in unused and decaying structures, however, rather than genuine primary contexts that reflect behaviours that occurred on the ancient surface while it was still in active use. The former situation is more probable, in fact, as few if any of these strata are sealed deposits – no significant upper bounding surfaces, such as collapse from a conflagration or other catastrophic event, were identified. This being the case, the Gudeda sample is therefore likely comparable in overall archaeological context to the other three sites, and eventual examination of the Gudeda material broken down by context should confirm if this is the situation or not.

Only the faunal material from Raq'a'i was recovered through use of a consistent hand-screening regimen, but several taphonomic indices reveal that the bias introduced by the lack of standard screening at the other sites is minimal (Rufolo 2011, 271–273). As the assemblages vary considerably in number of specimens, the greater concern is that any differences in species composition or taxonomic abundance observed among the sites may more closely reflect bias due to the disparity in sample size rather than any true differences at the population level. Minimum number of individual (MNI) counts, which

are free of the problem of statistical interdependence presented by number of identified specimen (NISP) figures (Grayson 1984, 17–49), were calculated for each site in the hope that a chi-square test could be performed to reveal the presence of statistically significant variations in assemblage composition based upon sample size. Unfortunately, the MNI numbers are too small to meet all the requirements for the test to be valid, specifically failing to possess a low enough percentage of expected frequencies that fall below a value of 5 in the contingency table calculated as part of the test. A basic assessment of sample-size bias was still possible employing the raw NISP data rather than MNI counts. A linear regression using the log-transformed values of the NISP figures for the *total number of specimens identified to the taxonomic rank of genus* for each of the four sites was run against the *number of confirmed genera* present for each assemblage (Fig. 16.4), returning a coefficient of determination (r^2) equaling 0.79. Nearly 80% of the variation in the presence or absence of specific taxa among the assemblages may therefore be explained by sample size alone. The breakdown of species present at each site, particularly when considering the smaller wild taxa, must be regarded more as a function of the number of specimens recovered and catalogued in the lab rather than as strongly signifying different species preferences at each site. The relative abundance of species present in common, however, varies less due to assemblage size. This was demonstrated with rank correlations using Spearman's rho statistic (Rufolo 2011, 257), which plot the *MNI count total for all mammalian taxa* of a site against the *specific percentage of that total* represented by individual mammalian species of both domestic and wild affiliation (caprine, pig, gazelle, fox) present in all four assemblages. The results indicate that a much smaller – but not completely negligible – 40% of variation in species abundances is accounted for by sample size ($r_s = 0.4$, $p = 0.05$ for all four taxa). Caution must therefore be used in interpreting these assemblages as whole units, especially when considering overall species composition. Comparisons of species abundances, however, are meaningful in distinguishing the basic pattern of animal usage. This is certainly the case for 'Atij and Raqa'i, which yielded the two largest sets of faunal remains.

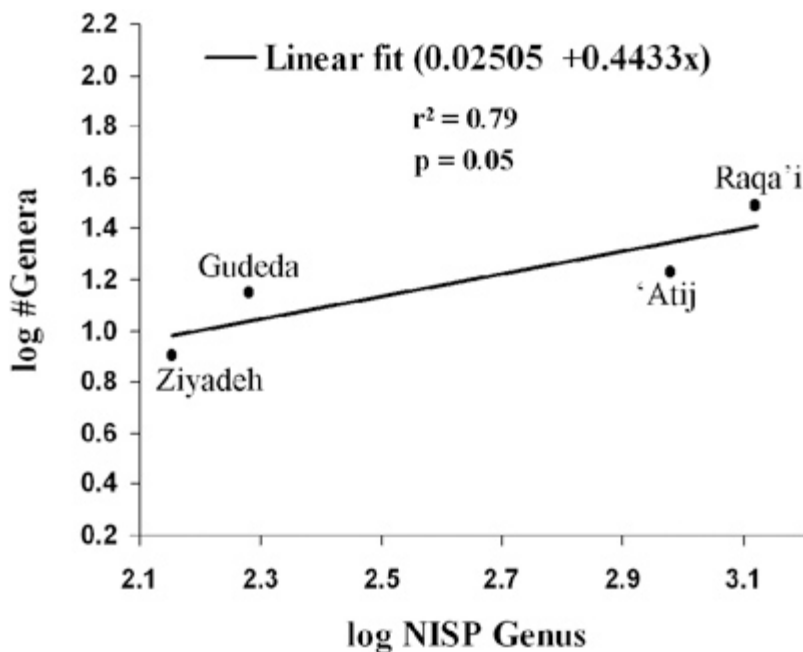


Fig. 16.4. Results of a log-transformed linear regression of the number of specimens identified to the taxonomic level of genus (x-axis) for each study site plotted against the number of genera identified for each assemblage (y-axis). The graph was generated using Microsoft Excel 2003 with the Analyse-it Standard Edition statistics add-in program, version 2.

The faunal data

Turning now to the actual species proportions, it may be noted that a general similarity characterises the assemblages. Looking first simply at the percentages of wild versus domestic species (Fig. 16.5 & Table 16.2), 'Atij, Gudedda, and Raqa'i clearly signal the dominance of domesticated forms at these sites. In comparison to the other two, however, 'Atij is characterised by a slightly greater proportion of wild taxa. The Ziyadeh data exhibit nearly equal representation of wild and domestic taxa, but the small sample size and its recovery from a restricted set of depositional locales preclude its direct comparison with the other assemblages. Distinctions of potentially greater significance emerge when comparing the breakdown of domestic species represented at each site (Fig. 16.6 & Table 16.3). Caprines (sheep and goats) are the predominant categories at all sites except Ziyadeh, with both 'Atij and Raqa'i displaying roughly similar proportions of the caprines categories. Once again, though, in

comparison with Raka'i and Gudeda, the 'Atij data present a noticeably different profile. In this case, pig and cattle remains are proportionately more common for 'Atij. Although possessing far fewer specimens overall, the particularly high frequency of sheep and goat for the Gudeda assemblage (comprising over 90% of the total) may nonetheless indicate a divergent set of provisioning methods in light of the fact that species abundances are not so strongly tied to sample size and the architectural remains of Gudeda differ from those of 'Atij and Raka'i. As previously mentioned, Gudeda has been described as being entirely devoted to manufacturing activities in the past and may therefore have housed only craftsmen who did not participate in diverse agricultural practices but were rather supplied with a more restricted range of animal-based products. Considering now the Ziyadeh sample, the high proportion of pig is likely an anomaly due to its very small size and narrow archaeological context, but it could also prove to hold significance once it can be more appropriately compared to specific levels and/ or areas of other sites following the completion of spatial and diachronic analyses. Regarding the wild fauna, gazelle and equid are the dominant categories (46.4% and 45.4% respectively for 'Atij, 44.3% and 17.3% for Raka'i, the two sites with the largest samples), the equid remains likely all representing the onager. These two species are accompanied by much smaller numbers of various other taxa such as aurochs, red fox, mustelids, rodents, birds, and turtles. As the wild component is relatively small and the taxonomic richness of the assemblages is strongly related to sample size, no significant patterns may be teased from these data concerning the non-domesticated resources at this level of analysis.

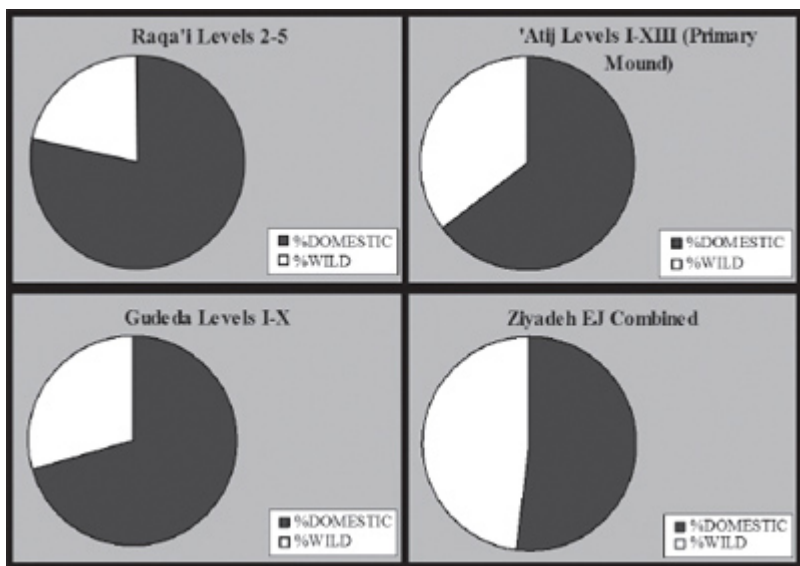


Fig. 16.5. Pie charts depicting proportions of wild and domestic taxa recovered from the four sites discussed in the text based on the data presented in Table 16.2.

Table 16.2. Proportions of domestic and wild species for that portion of each assemblage listed in the 1st column that could be identified to taxonomic categories permitting such a distinction. The 2nd column provides the specific number of specimens belonging to this identified portion, followed by the number of specimens of these totals representing domestic and wild forms, and their associated percentages, in the remaining columns. Data in this table are shown graphically in Figure 16.5.

Site	NISP total	NISP domestic	% Domestic	NISP wild	% Wild
'Atij	1920	1238	64.5	682	35.5
Gudeda	482	340	70.5	142	29.5
Raqa'i	2669	2098	78.6	571	21.4
Ziyadeh	204	106	52.0	98	48.0

The overall species proportions are similar among the sites, keeping in mind the disparity in sample sizes, and the generally high number of sheep and goats confirms the finding of the preliminary zooarchaeological study that pastoralism was an important component of the subsistence economy of the Middle Khabur. Within the caprine category, the ratio of sheep to goat varies between sites from 2.1:1 to 2.4:1, a balance that is typical for generalised pastoralism as practiced

in the Middle East (Redding 1984). With the additional data obtained from the second round of examination, one may begin to explore the caprine material in greater detail in order to profile the type of pastoral practices employed during the first half of the Early Bronze Age in this region. Age profiles have been constructed based upon assessment of both limb bone fusion and the stage of mandibular dental wear in accordance with procedures established by Zeder (1991, 89–95; 2006). For long-bones, specimens were coded to reflect their fusion state – unfused, fusing, or fused – and then tabulated according to the species specific fusion groups which class skeletal elements together based on those whose period of epiphyseal fusion occurs within a similar age range. This information was then used to generate survivorship curves that chart the estimated percentage of animals in a hypothetical ‘average’ herd reconstructed for the entire assemblage from a site (this herd representing a cohort of animals born in a single year) that survived beyond the upper limit of each age class during a period of time representing the general lifespan of caprines. A specimen of a sheep tibia of which the distal end is fused represents an animal that survived beyond 18 months, as by this age the lower end of this bone knits together with its cap, whereas one with an unfused distal end comes from an individual that died before reaching 18 months. In contrast, the state of tooth wear in the lower jaw was documented for sheep and goat mandibular specimens so that mortality rather than survivorship profiles could be established. The sequence in which dentine is exposed on the chewing surface of the teeth proceeds in a regular fashion with age, thus allowing the pattern of tooth wear exhibited by relatively intact mandibles to be used to estimate age at death in a more exact fashion. The mortality profiles highlight the percentage of the hypothetical herd that perished within a given age range, these ranges being of greater resolution than those for long bone fusion and also extending into older age categories. Taken together, the two types of aging data reveal how ancient herds were being managed to create a certain age and sex composition, the specific composition being tailored to support particular goals.

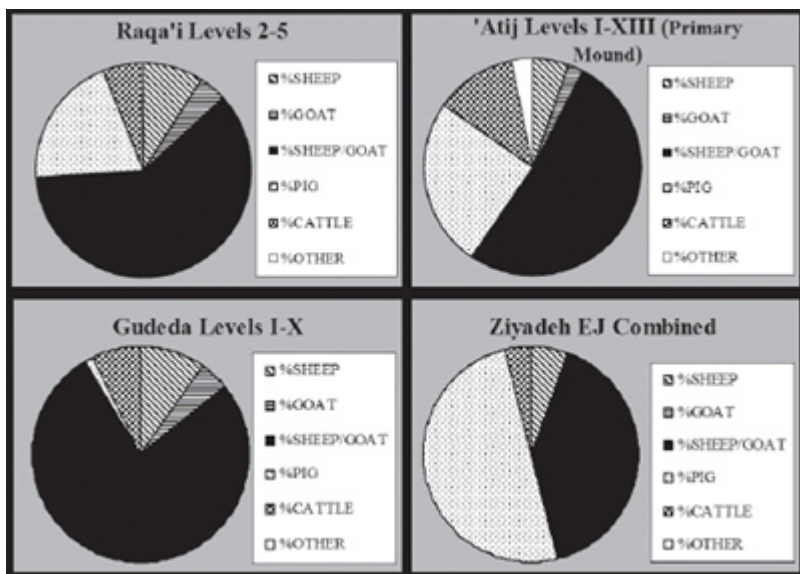


Fig. 16.6. Pie charts depicting the breakdown of domestic taxa recovered from the four study sites based on the data presented in Table 16.3. Sheep are represented by diagonal lines, goats by horizontal gray lines, sheep/goat or caprines by solid black, pigs by light gray texturing, cattle by black and white checkerboard, and other species by open white.

Focused culling strategies intended to balance or maximise particular pastoral goods have been modelled in terms of the distinct survivorship curves expected to be produced based on ethnographic data and theoretical projections (Payne 1973; Redding 1981; Vigne & Helmer 2007). A summary of the most commonly consulted model curves is shown in Figure 16.7. These reference graphs establish the general trends in the aging data that signal the varying herd management strategies rather than chart exact survival percentage values and their corresponding curve shapes that must be met in order to conclude that a specific pastoral product was a goal. These signature curves predominantly represent theoretically ideal situations in which herds are single-mindedly manipulated to generate the best yields possible or create a demographically robust herd profile to maximise animal survival in years of drought or disease, but studies such as those of Schneider (1984), Black-Michaud (1986), and Bowen (1994) have shown that pastoral practices outside of the highly diversified, technological advanced markets of the modern world tend to reflect mixed strategies that often involve slaughter and trade of animals from a fairly broad range of ages and sexes. Ancient herding would have been structured to a significant degree by the cultural framework and economic vagaries of the period, flexibility and the

maintenance of a diversity of resources remaining a prominent feature in many cases even if wool or dairy receives a special focus (Green 1980; Crabtree 1996). Evaluating the best fit of a survivorship curve derived from archaeological remains in comparison with the model curves is also hampered by the fact that these reference curves are not readily distinguishable from one another in terms of statistical significance (Marom & Bar-Oz 2009). In light of these difficulties and the central concern of this paper, the focus here is on the basic shape of the curves generated for the Middle Khabur sites with reference to the wool profile shown in [Figure 16.7](#). Unlike the curves for all the other model herding strategies, that for wool production exhibits no sharp drops until after the age of 6 years, and up to that point the curve is comparatively more stable. Animals managed for wool are also characterised by high survivorship beyond 2 years of age, with 50% of the herd still alive after 5 years. This reflects the fact that animals of both sexes are being kept into adulthood, older individuals increasingly being culled as their wool decreases in quality due to advancing age, with a small proportion of young animals being killed for meat or dying of natural causes. A similar pattern of elevated representation of the older age ranges with a gradual decline in survivorship should be present in the zooarchaeological data if a strong emphasis on wool extraction characterised the pastoral economy of the Middle Khabur communities.

Table 16.3. Breakdown of domestic taxa for each site. The total number of specimens representing domesticated species is given in the 2nd column as identified for each site . The remaining columns provide the proportions of the 2nd column figure held by each domestic category in both count and percentage. The category labelled ‘Caprine’ includes specimens that may be either sheep or goat and the ‘Other’ column includes dog and cat remains. Cattle includes all specimens that clearly represent the domestic cow as well as those identified only to genus (Bos sp.).The latter technically could be the remains of small individuals of wild aurochs (B. primigenius) but their appearance and dimensions do not immediately recommend assignment to this taxon.

Site	NISP total	NISP (%) sheep	NISP (%) goat	NISP (%) caprine	NISP (%) pig	NISP (%) cattle	NISP (%) other
‘Atij	1238	66 (5.33)	28 (2.26)	643 (51.94)	312 (25.20)	150 (12.12)	39 (3.15)
Gudeda	340	33 (9.71)	15 (4.41)	263 (77.35)	4 (1.80)	25 (7.35)	0
Raqa’i	2098	188 (8.96)	89 (4.24)	1276 (60.82)	417 (19.88)	121 (5.77)	7 (0.33)
Ziyadeh	106	6 (5.66)	0	43 (40.57)	130 (50.00)	4 (3.77)	0

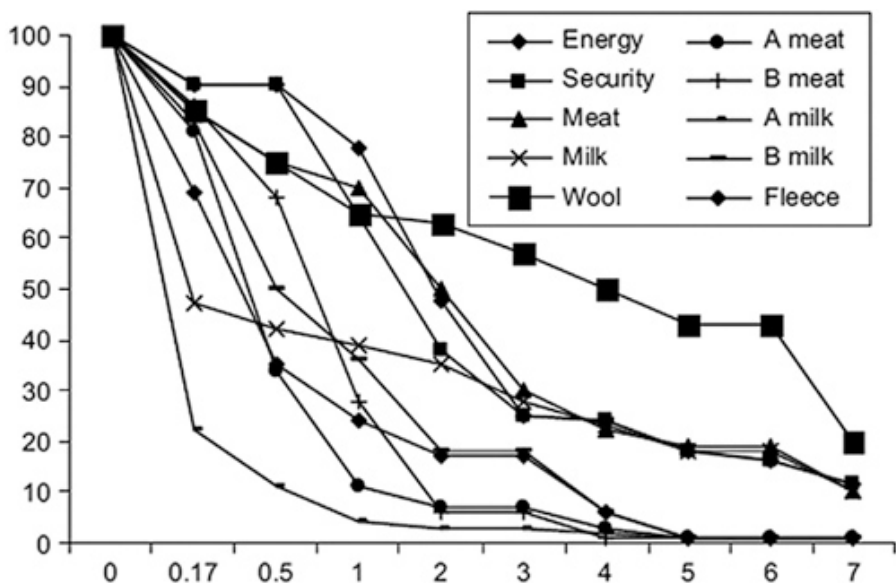


Fig. 16.7. Survivorship curves for the most commonly used model culling strategies for caprine herds (from Marom & Bar-Oz 2009, fig. 1). Age in years is plotted across the x-axis and the surviving percentage of the original herd on the y-axis.

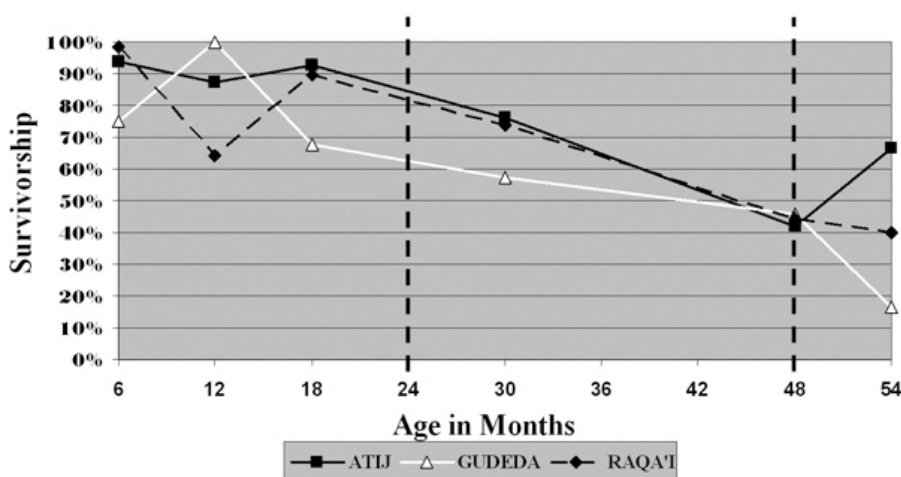


Fig. 16.8. Caprine survivorship curves for 'Atij, Gueda, and Raka'i based on the percentages presented in Table 16.4. The dashed lines enclose the decline in survivorship for the age range of 2–4 years. See caption for Table 16.4 regarding the false signals of increase in survivorship seen in parts of the curves outside of the dashed lines.

The Ziyadeh assemblage does not contain the minimum number of remains identifiable as sheep or goat necessary for the charting of age classes, but long bone fusion status could be used to do so for the

remaining three sites. Furthermore, a large enough set of dental material was also recovered for the use of mandibular tooth wear stages to age caprine specimens from both 'Atij and Raqa'i. Considering first the survivorship curves derived from all ageable caprine long-bone specimens (Fig. 16.8 and Table 16.4), which combines sheep and goat remains in order to obtain the largest possible sample size but which thereby mixes the data for the two species which may have been managed in very different ways, it can be seen that the same general pattern is displayed for all three sites. The fusion data reveal a significant decrease in survivorship of animals aged 2–4 years, indicating an extended culling period loosely concentrating on young adults. For 'Atij, Gudeda, and Raqa'i, over 50% of caprines failed to survive beyond 4 years of age. The curves for 'Atij and Raqa'i, however, do signal greater survivorship in the 1.5–2.5 year age range in comparison to Gudeda, so if sheep were managed differently than goats at these two sites than perhaps the greater survivorship of the sheep is responsible for elevating the curves. The basic profiles evident in the long-bone data for 'Atij and Raqa'i also emerge in the dental age distributions for these sites (Table 16.5 & Figs. 16.9–10). The caprine mandibles and associated teeth – which were not well enough preserved either in terms of sufficient quantity or condition to permit distinguishing species based on methods developed to do so (Helmer 2000; Halstead & Collins 2002; Zeder & Pilaar 2010) – represent all age classes to some degree, but there is a clear focus in the dental wear stage distributions for both sites on animals 2–4 years old, with a possible secondary culling of animals detected in the 6–8 year range. These peaks in mortality reflect a generalised herding strategy for both sheep and goats oriented to support local consumption and maintain herd security with a low-level offtake of secondary products, not the slaughter pattern expected for wool production which entails a principle reduction of herd size focusing on animals six years and older with low levels of culling for animals or younger age. Nor is dairy production in evidence, which requires a primary slaughter of male animals before one year of age.

Table 16.4. Caprine long-bone age distributions following Zeder (2006). The percentages indicate the estimated proportion of animals surviving beyond each age with reference to the initial population (specimen counts in the bottom row), the figures in parentheses indicating the number of specimens attributable to each age class on which the calculations are based. The method used to determine survivorship within an age group

calculates the percentage based on only those specimens assigned to that particular age range rather than the entire assemblage of ageable long-bones. Variation in the distribution of limb elements within each class due to taphonomic factors that differentially influence the recovery rates of skeletal elements based on size and bone density occasionally result in 'resurrections' – increases in survivorship along certain parts of the curve when survivorship should only decline over time (Zeder 1991, 94). This is a statistical artefact caused by uneven sample size within age range categories. Those segments of the curve that decrease in succession approximate the correct trend within the data.

<i>Age class (months)</i>	<i>'Atij % (no.)</i>	<i>Gudeda % (no.)</i>	<i>Raqa'i % (no.)</i>
A (0–6)	93.75 (16)	75.00 (4)	98.21 (28)
B (6–12)	87.50 (32)	100.00 (22)	64.77 (88)
C (12–18)	92.86 (21)	67.86 (14)	89.90 (99)
D (18–30)	76.04 (48)	57.14 (14)	73.89 (90)
E (30–48)	42.00 (25)	45.95 (37)	42.73 (110)
F/G (48–54)	66.67 (6)	16.67 (6)	36.36 (11)
Total no. elements	148	97	426

Table 16.5. Caprine age distributions based on dental wear for the sites of 'Atij and Raqa'i following the method of Zeder (2006). The percentages give the proportion of the total population that perished in each age class.

<i>Age class</i>	<i>'Atij %</i>	<i>Raqa'i %</i>
I (0–2 months)	5.88	4.88
II (2–6 months)	3.92	10.57
III (6–12 months)	0.98	3.25
IV (12–18 months)	4.90	5.69
V (18–24 months)	20.59	20.33
VI (2–3 years)	8.33	16.67
VII (3–4 years)	21.57	20.33
VIII (4–5 years)	11.27	4.47
IX (5–6 years)	6.86	3.25
X (6–8 years)	14.71	7.72
XI (8–10 years)	0.98	2.03
XII (10+ years)	0	0.81
Total no. mandibles	34	41

To explore the possibility of a local wool-based economy even further, perhaps signaled by the higher general caprine survivorship displayed by the 'Atij and Raqa'i fusion data contrasted with those for Gudeda, one must consider the information afforded by the sets of long-bone specimens attributable specifically to sheep. As mentioned earlier, only the sites of 'Atij and Raqa'i supplied these in sufficient

quantity to permit the construction of age profiles for this taxon based on epiphyseal fusion (Fig. 16.11 & Table 16.6). Interestingly, the profiles for both sites are very different in form from the combined caprine curves, exhibiting higher survivorship of animals through the 2–4 year age period (63–83% survivorship by the age of 4 compared to the 42–43% exhibited by the general caprine curves). The resolution of the fusion data fades after the 4 years mark, and is usually picked up by dental wear information which is more sensitive to older age classes. Unfortunately, as no dental material could reliably be classified to the species level for sheep, the slaughter of older animals expected for wool production cannot be detected with the available data. The comparatively high survivorship of young adult animals may nonetheless suggest that sheep were indeed raised in large part for their wool, but this pattern may also be attributable more to the fact that only a restricted set of elements are used to distinguish sheep from goat of which the pertinent morphological features may be less developed in younger animals. Specimens representing young sheep would therefore be more difficult to classify as such and were differentially left in the sheep/goat category. This would certainly seem to be the case for animals less than 2 years of age, as the goat long-bone specimens from Raka'i, the site among the four which furnished the largest sample of goat elements for which fusion could be assessed, also show near 100% survival by the age of 24 months (Fig. 16.10). The goat survivorship data, however, declines more rapidly following this point to reach 42% by 48 months. This difference likely signals that wool was systematically procured to some degree, but it would have been on a small scale as the accompanying faunal signature is obscured in the combined caprine profiles. Moreover, the ratio of sheep to goat for 'Atij and Raka'i, as well as for Gudeda, which ranges between 2.1 and 2.4 to 1, is well below the 6:1 ratio expected for sites involved in large-scale generation of wool (Redding 1992).

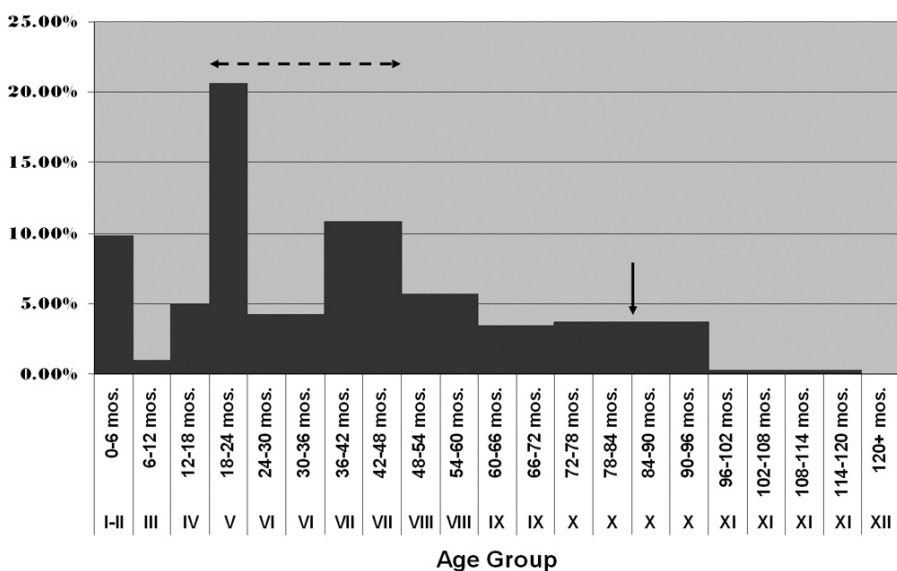


Fig. 16.9. Caprine mortality profile for the site of 'Atij presented as a histogram based on the percentages given in Table 16.5. The data have been apportioned into equal intervals of 6 month periods. The dashed-line arrow indicates the 2–4 year range in which two spikes indicating elevated mortality are displayed; the solid vertical arrow points to a low peak possibly indicating the secondary culling of older females.

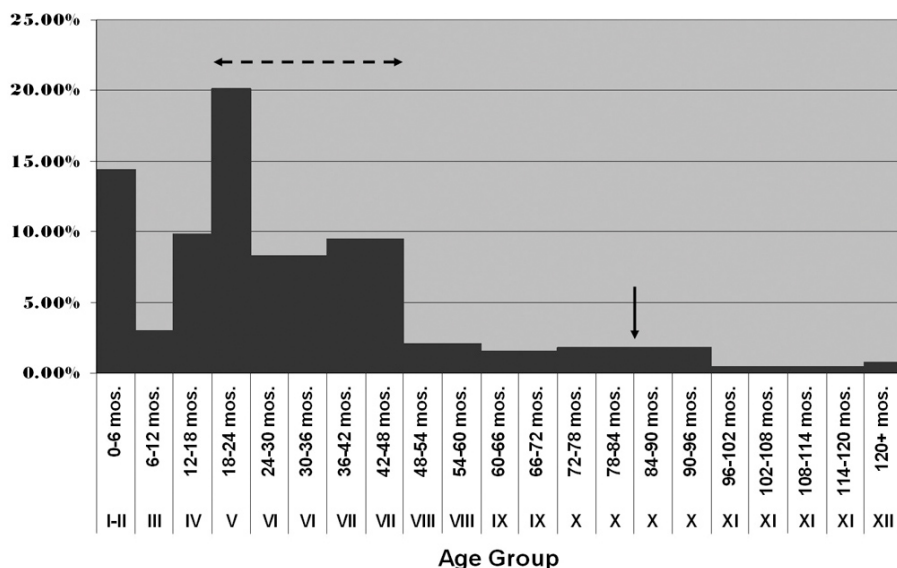


Fig. 16.10. Mortality profile established for the caprine dental wear data for the site of Raka'i based on the percentages given in Table 16.5. The data are presented as a histogram with a bin interval of 6 months. As for the 'Atij data, two spikes in mortality are evident around the ages of 2 and 4 years (below the ends of the dashed-line arrow) with a less-pronounced

culling possibly indicated between 6 and 8 years (as indicated by the solid vertical arrow).

Conclusions and future directions

The Middle Khabur sites treated here, possessing faunal assemblages with caprine ageing data that fail to clearly signal pastoral specialisation focused on a single product, appear to have not been dedicated to the accumulation of wool or any other animal-based resources on a significant scale. The slightly higher survivorship of sheep attested in the 'Atij data when viewed against the survivorship curve for sheep derived from the Raqa'i assemblage may indicate that the inhabitants of 'Atij managed their sheep flocks for wool production to a greater extent, perhaps even acting as a small source for supplying urban needs, but this emphasis on fleece extraction was not particularly intensive. Faunal analysis concerning the nearby site of Tell Bderi, a relatively large settlement established further to the south along the middle stretch of the Khabur and occupied between around 2750–2300 BC, exhibits a similar lack of zooarchaeological markers for a highly specialised pastoral production (Omar, this volume). All four sites examined here present a similar array of species and ageing data indicative of a more indiscriminate exploitation of domesticated resources, an exploitation that was perhaps slightly different at each site as suggested by the differences in the 'Atij and Raqa'i ovine age data. The component of the agricultural economy centred on sheep and goats, undoubtedly an important and welldeveloped aspect of the subsistence strategy by the later phases of occupation, nonetheless likely did not include a large-scale, organised extraction of animal fibre in which all sites participated to fuel an expansive, interregional textile industry. This is perhaps not surprising for the first half of the Early Bronze Age, as unlike the examples of Tuneinir and the later urban centers of the northern Khabur Basin, none of the Middle Khabur sites examined here was reported to have numerous artefacts associated with extensive wool processing. In addition, it has recently been suggested that archaeobotanical occurrences of *Carthamus tinctorius* throughout the Near East imply that this species was as – or perhaps more – important as a source of oil during the Early Bronze Age rather than as raw material for manufacturing dye (Marinova & Riehl 2009). The zooarchaeological data presented here support an interpretation of the Middle Khabur subsistence economy as having been oriented primarily to meet local needs through a generalised, low-level dependence upon caprine meat and secondary products. This echoes

the results of Stein (1987) regarding the 3rd millennium BC faunal material from Gritille Höyük, a small village site located in the Karababa Basin of the Euphrates river valley where it winds through southeastern Turkey. This area also underwent an urbanisation process during the Early Bronze Age, one in which small communities of the rural hinterland were not strongly integrated economically into the regional urban economy.

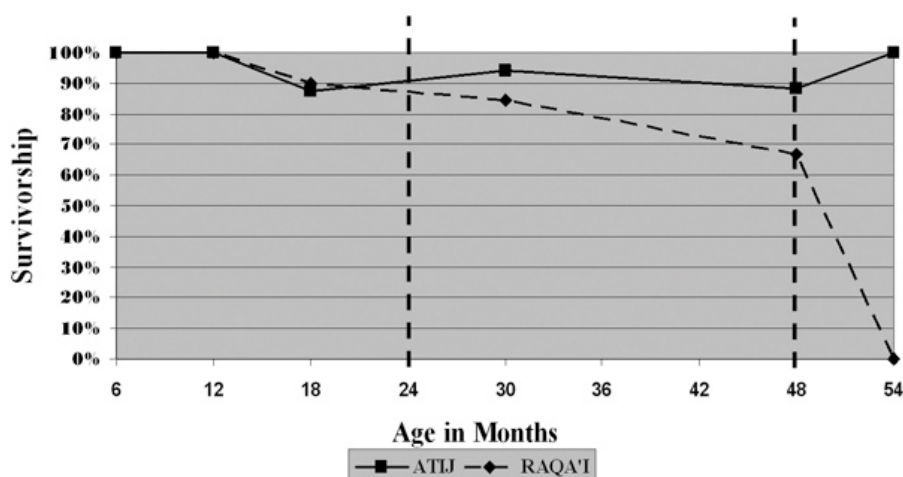


Fig. 16.11. Sheep survivorship curves for 'Atij and Raqa'i based on the percentages presented in Table 16.6. The dashed lines enclose the age range of 2–4 years during which survivorships remains comparatively higher than that exhibited by the general caprine survivorship curves for these sites as shown in Figure 16.8.

Table 16.6. Sheep long-bone age distributions (for the sites of 'Atij and Raqa'i) and also for goat (Raqa'i only). See description of Table 16.4 for conventions. The corresponding survivorship curves for the sheep data only are shown in Figure 16.11.

Age class (months)	'Atij: sheep % (no.)	Raqa'i: sheep % (no.)	Raqa'i: goat % (no.)
A (0–6)	100.00 (3)	96.43 (14)	100.00 (4)
B (6–12)	100.00 (10)	76.92 (13)	0
C (12–18)	87.50 (8)	91.18 (34)	100.00 (27)
D (18–30)	94.23 (26)	87.50 (44)	85.71 (21)
E (30–48)	83.33 (3)	62.50 (32)	41.67 (6)
F/G (48–54)	100.00 (1)	0	0
total no. elements	51	137	58

The broader effects of the development of early urbanstate complexes in Mesopotamia and surrounding regions were likely a highly variable affair, a situation that may have been characteristic for most primitive states throughout the ancient world (Johnson & Earle 2000, 251–264; Spencer 1990; Yoffee 2005). In discussing the social forces behind the urbanisation of the ancient settlement of Urkesh, the modern archaeological site of Tell Mozan located in the far northern Khabur Basin and which ranks among the urban centres that coalesced in that region during the later Early Bronze Age along with Leilan, Buccellati (1990, 237) denotes those areas of the countryside surrounding city-states whose economies are directly dependent upon the urban center as constituting the para-urban sphere. The Middle Khabur communities may have been an element of this para-urban hinterland, representing the initial stage of this phenomenon in which dependence on urban demand developed concerning craft production but which never fully matured to integrate agricultural production on a large scale. Alternatively, perhaps the Middle Khabur settlement constituted an opportunistic response to prospects afforded in a sparsely inhabited region between developing urban spheres and their immediate environs – an inter-urban phenomenon rather than a para-urban one. It has already been suggested that these communities may have functioned as an economic gateway, supporting riverine trade plied along the Middle Khabur between emerging urban populations in the northern part of the basin and those outside the basin to the south (Fortin & Schwartz 2003, 225). Minor differences in subsistence economy and animal management patterns among the villages – such as the relatively greater emphasis on pig and cattle at ‘Atij in comparison with Raqa’i, combined with a possible low-intensity focus on sheep for wool – could then be viewed as competition avoidance, a common feature of modern urban-rural relationships (Kramer 1994), each settlement specialising in certain animal products to produce a diverse range of exports for cities rather than all being integrated into a single industry. Such possibilities will be further explored in future works that will consider the zooarchaeological data more thoroughly, parsing the species proportions more completely, considering diachronic changes by level, including survivorship profiles for other taxa – both domestic and wild, and surveying comparative faunal data for other sites in the region to profile contemporaneous trends in both urban and rural contexts over the course of the 3rd millennium BC.

However the specific details may evolve in the future, an initial reading of the faunal data supports the notion of an internal

development of a confined economic sphere, at least regarding the animal-based economy, in which communities along the Middle Khabur were principally involved in exchange with the pastoralist populations of the surrounding steppe, storing grain to support nearby herds and to serve as a general commodity, perhaps also used in conjunction with other agricultural products to supply tradesmen moving goods along the river with foodstuffs needed for the journey. While the majority of agricultural resources were utilised locally, craft production at these sites likely linked the riverside settlements into a developing trade conducted via the river between the emerging urban centres of the north and the growing cities outside the basin to the south. In this way, both mobile and sedentary populations of the Middle and Lower Khabur regions participated in and facilitated the socio-economic structures that enabled urbanisation within the basin, without becoming wholly subordinate to external entities or completely isolated from them. The trajectory to statehood within the Khabur may then be best envisioned as a slow crystallisation of diffuse socio-economic networks that operated throughout the basin – urban, para-urban, and inter-urban constructs tied to one another in varying degrees of economic inter-dependence –and whose broader details will hopefully become clearer as the second-stage analysis of the Early Bronze Age Middle Khabur sites continues.

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Part 4

Pastoralism, nomadism and mobility

17. Fish and mammal bones in the Abu Dhabi desert: evidence for Bedouin diet during the pre-oil era

Mark J. Beech, Hanae Sasaki, Tatsuo Sasaki, Walid Yasin Al-Tikriti and Mohammed Amer Al-Neyadi

Archaeological research in south-east Arabia has rarely concentrated on the recent historical period. This paper presents the results of an investigation of three Bedouin campsites located on the traditional migration route between Abu Dhabi and Liwa in the United Arab Emirates. Analysis of pottery from these sites dates them to between the latter half of the 18th century to the 20th century. Investigation of the animal bones from these sites provides a new insight into the animals accompanying the people on these regular migrations, as well as demonstrating the diet of pre-oil era populations in Abu Dhabi emirate.

Keywords Bedouin, diet, desert archaeology, dried fish, camels, caprines

Introduction

Archaeological research in south-east Arabia has rarely concentrated on the recent historical period. This is surprising considering the lack of written accounts documenting the life of traditional Bedouin communities inhabiting the deserts of south-east Arabia.

Our understanding of the life of traditional Bedouin society in this region is primarily dependent on photographs and written accounts made by foreign visitors who either lived or passed through the region. These included the German traveller Hermann Burckhardt who took some of the earliest recorded photographs in 1903 of Sheikh Zayed Bin Khalifa. The British explorer Wilfred Thesiger who crossed

the Empty Quarter twice between 1945 and 1949 described in some detail the vanishing way of life of the Bedouin, vividly described in his classic travel book 'Arabian Sands' (Thesiger 1959). Thesiger took many photographs during his travels and donated his vast collection of negatives to the Pitt Rivers Museum in Oxford. A valuable series of photographs were also taken by the British oil company executive Ronald Codrai, who worked in the Trucial States from 1948 to 1955, and who then frequently visited the country until just before it became the United Arab Emirates in 1971 (Codrai 1990). Codrai managed to photograph all the rulers of the seven Emirates, as well as taking many important photos documenting aspects of daily life at that time.

Our knowledge of the historical past is supplemented by the more recent accounts of UAE-based historians (e.g. Heard-Bey 1996) and UAE nationals who have written memoirs reminiscing about their childhoods (e.g. Al Fahim 1998).

These photographs and accounts provide some clues as to the dress and general attire of these communities, as well as everyday activities such as tending camels, preparation and drinking of coffee, falconry, the collection and transportation of water, the general appearance of '*arish* (palm frond) type house structures, harvesting of dates, fishing-related activities, pearling, selling items in the souq, etc.

Some of these observers, like Thesiger, have glorified the nobility of Bedouin life, whilst more recently local cultural and media organisations have often used airbrushed images to create a romanticised nostalgic view of the past. In actual fact, older Emiratis who lived in the 1940s and 1950s talk about how hard life was, and mention the importance of small industries like firewood, charcoal, chickens, goats and vegetables, that allowed them to survive (Bristol-Rhys 2011). There have been some studies looking at travellers observations of Bedouin food (cf. e.g. Iddison 1996).

What do we actually mean when we use the generic term 'Bedouin'? It is unfair to characterise the entire population of the region as being desert nomads. The situation was of course much more complicated. Some communities were settled in economically viable locations, others were nomadic groups, combining herding, hunting and fishing. A key point is the seasonal nature of the climate in south-east Arabia. The extreme heat and humidity of coastal areas during the summer months led part of the population of Abu Dhabi to switch to the less humid interior oases, such as Al Ain and Liwa (Cordes & Scholz 1980; Heard-Bey 1996). This of course coincided with the beginning of the

season for harvesting dates from the oasis date palm gardens. Pearling activities, however, required that part of the coastal communities remained on the coast during the summer months, when pearling was traditionally carried out. Trade and commerce also meant that some merchants remained in coastal ports. Another important phenomenon to consider in the more recent historical period is the growth of largely urbanised populations, who live with the trappings of urban life, but whom still annually migrated to the interior oases at the onset of the hot summer season.

Bedouin campsites in the Abu Dhabi desert

Since the mid-1990s both the Abu Dhabi Islands Archaeological Survey (ADIAS) team, as well as the former Al Ain Department of Antiquities and Tourism, were aware of the existence of a number of Bedouin campsites located between Abu Dhabi and Liwa, approximately 65km south-east of Abu Dhabi, the capital of the United Arab Emirates. These were located in two areas known as Tawi Beduwa Shwaiba and Muray ([Fig. 17.1](#)). Various local UAE nationals had brought to their attention the presence of complete pottery vessels collected in an area of sand dunes where hand-dug wells had been exploited, and where scatters of pottery, mammal and fish bone, and marine shells were observed. Some of these complete pottery vessels were curated by both aforementioned organisations, which are now integrated within the Abu Dhabi Tourism and Culture Authority (TCA Abu Dhabi).

In late April to early May 2008 a team of archaeologists from Japan's Kanazawa University and the former Abu Dhabi Authority for Culture and Heritage (ADACH) carried out a more detailed investigation of a number of these sites. This paper concerns an analysis of the fish and mammal bones retrieved from these remarkable historic desert campsites.

Methods

The survey and excavation team included the following members: Department of Archaeology, Kanazawa University, Japan: Professor Tatsuo Sasaki and Dr Hanae Sasaki; Historic Environment Department at the former Abu Dhabi Authority for Culture and Heritage (ADACH), now known as the Abu Dhabi Authority for Tourism and Culture (TCA Abu Dhabi): Mohammed Amer Al Neyadi (Head of Department), Dr Mark Beech (Head of Coastal Heritage and Palaeontology section), Dr Walid Yasin Al-Tikriti (Head of Archaeology section), Ali Al-Meqbali, Ahmed Al-Haj, Dia'eddin Tawalbeh, Hamdan Al-Rashedi, Mohammed

Al-Dhaheiri and Jaber Al-Merri (Archaeologists).

The three main sites investigated are difficult to access and required skilled off-road driving in the sand dunes to approach the sites. Nissan Patrol 4WD cars were used to approach the sites. It was necessary to deflate the tyres to provide better traction in the loose sands of the area, as well as to have safety and rescue equipment, including tow ropes, steel cable winches and shovels.

Local UAE nationals, who had been travelling through the area, first identified the sites investigated. Baqit Saeed Al Mansouri acted as a local guide helping us navigate to these sites. Initial work at the site in late April 2008 concentrated on GPS mapping of the precise location of these sites. Co-ordinates were taken using a Garmin handheld GPS in decimal degrees with WGS84 as the datum.

Samples of pottery, fish bones, mammal bones and marine shells were collected from the surface of each of the three sites under investigation. These were all random grab samples, with the exception of a small quantity of material collected during the excavation of the test trenches at Muray site 1. As the sample size is quite small all this material is simply treated on a site-by-site basis. The methodology adopted for studying the fish bones is that defined earlier by Beech (2004).

Location

The three principal sites investigated during this survey were Muray site 1 (also known as Bad Al Muray), Muray site 2, and Tawi Beduwa Shwaiba (Fig. 17.2).

Muray site 1 (Bad Al Muray) is located at 54.64250 E, 23.87444 N, approximately 70km south-east of Abu Dhabi, the capital city of the United Arab Emirates. The site was first discovered by a UAE national in December 2007. A team from the Historic Environment Department, including Ahmed El Haj, at the former Abu Dhabi Authority for Culture and Heritage visited the site during the same month, and collected some initial samples of pottery sherds from the site. The joint Japanese – ADACH team then made a survey on 28 April 2008, followed by trench excavations from 5–6 May 2008. A further pottery scatter covering an area of about 20 × 10m, consisting of earthenware potsherds and fish bones, was noted to the south-west of Muray site 1 on 6 May 2008. This was designated as Muray site 1 – area C.

Muray site 2 is located at 54.70105 E, 23.88772 N, just 6km north-east of Muray site 1 (Bad Al Muray). The site was first discovered by a local UAE national in December 2007. The joint Japanese – ADACH

team surveyed the site on 29 April and 6 May 2008.



Fig. 17.1. Location of Tawi Beduwa Shwaiba, Muray site 1 (Bad Al Muray) and Muray site 2 in Abu Dhabi emirate. Scale bar is 100km.

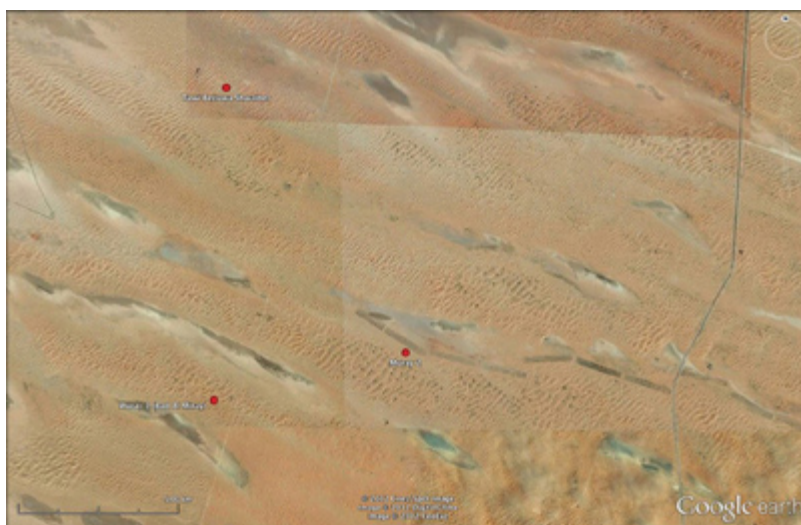


Fig. 17.2. Location of the sites studied. Note the locations of all three sites within the sand dunes. Scale bar is 5km.

Tawi Beduwa Shwaiba is located at 54.64781 E, 23.96403 N, approximately 60km south east of the city of Abu Dhabi. The site was first noted in 1992 in a brief visit by the former Al Ain Department of Antiquities and Tourism, who collected some ceramic finds from the site which are curated in the collections of Al Ain National Museum. In 1997 Mubarak Mohammed Al Mansouri, a UAE national who had

known the area since his childhood, found a number of pottery vessels which had appeared due to recent dune movement. He collected the vessels and brought them to Sheikh Mohammed bin Butti Al Hamed, who at that time was the Governor of Al Gharbia. Escorted by Mubarak, a team from the Abu Dhabi Islands Archaeological Survey (ADIAS) then visited the site in September 1997. A number of complete vessels, as well as samples of potsherds, were collected and curated within the ADIAS archives. A preliminary assessment suggested that these were all of Late Islamic date, probably dating from the 17th century AD onwards. Mubarak Mohammed Al Mansouri described the site as having been 5 days camel ride from Liwa en route to Abu Dhabi. He remembered it as having been in use during his childhood, around 50 years ago, and that he had been informed that it had been in use as far back as the time of his grandfather's grandfather. A more detailed investigation and report were subsequently issued by the ADIAS team (ADIAS Newsletter 1997; Hellyer 1998). The joint Japanese–ADACH team re-surveyed Tawi Beduwa Shwaiba on 1–7 May 2008. More recent dune movements had exposed further traces of the archaeological remains. Four different areas were identified within the site, designated as areas A, B, C and D (Fig. 17.3).

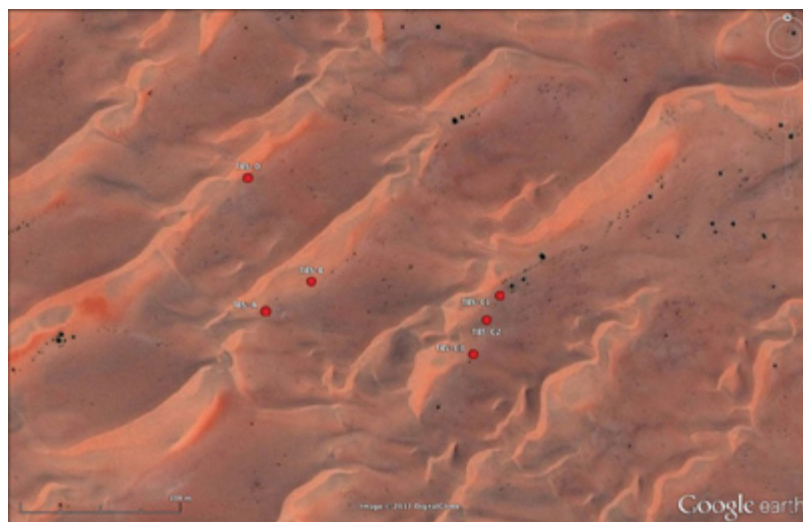


Fig. 17.3. Tawi Beduwa Shwaiba. Note the relative position of the sub-site areas: TBS-A, TBS-B, TBS-C1, TBS-C2, TBS-C3 and TBS-D. Scale bar is 100m.



Fig. 17.4. View of Muray site 1.

Muray site 1 (Bad Al Muray)

Scattered ceramic sherds and animal bones (both mammal and fish bones) were discovered spread over an area measuring 54m north–south by 50m east–west. This was located on the lower southern slope of a sand dune inclined down gently to the north, and on the surface of an interdunal hollow besides a pronounced high sand dune to the north (Fig. 17.4). Sand dunes located to the north and south were about 10–15m in height from the base of the interdunal hollow. Vegetation was very sparse in this location and no trees were found around the site.

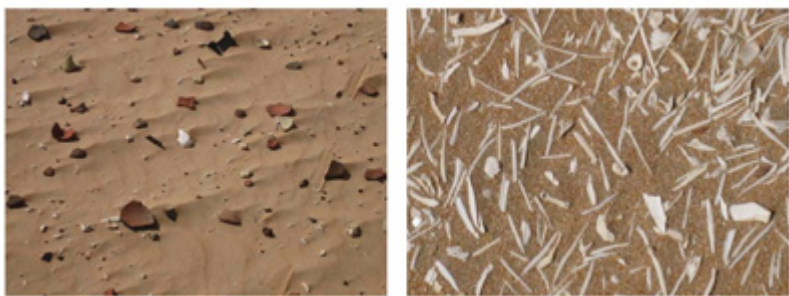


Fig. 17.5. Close-up view of the occupation deposits at Muray site 1.

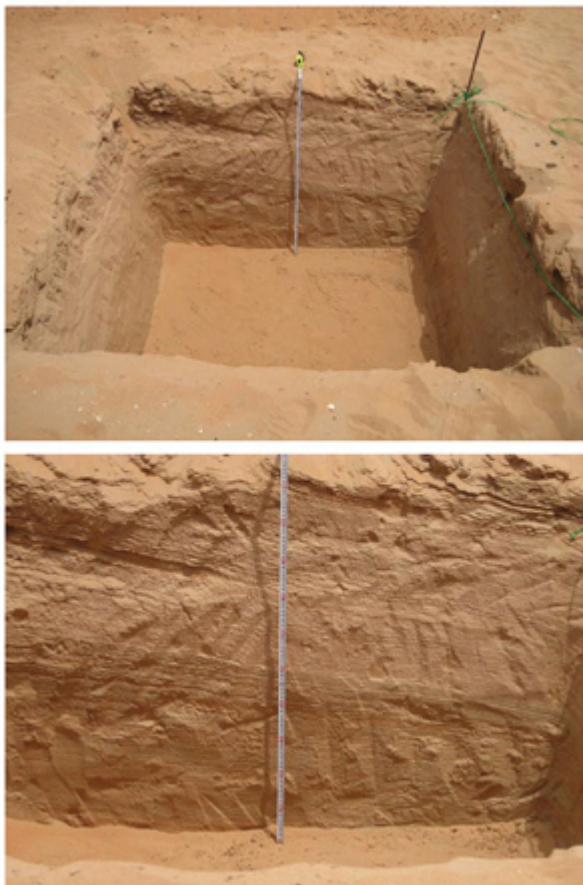


Fig. 17.6. View of the two test trenches excavated at Muray site 1.

Many small scattered fragments of ceramics were noted on the surface, as well as small fish bones and scales (Fig. 17.5). A number of mammalian bones were also noted. These were numerous small sherds of unglazed reddish ware and small sherds of glazed ceramics. Unglazed sherds consisted of cooking pots and various jars used for preserving food items. One complete earthenware basin was found on the southern slope, almost at the southern limit of the pottery scatter. Large bowls of Iranian under glazed painted ware are dominant amongst the glazed wares. Brown glazed vases and large bowls from Bahla in Oman are the next most common type. Yellow glazed bowls and green glazed bowls are present in small quantities. Chinese blue-and-white bowls and dishes from Fujain province are present. These were typical export wares during the 19th century. Chinese small cups for coffee dating from the 20th century were also found. European ceramics such as bowls and plates from Holland and Britain were also recorded. Overall, the ceramic assemblage suggests that the site was

occupied during the Late Islamic period, some time between the latter half of the 18th century right up until the mid-20th century.



Fig. 17.7. View of Muray site 2.



Fig. 17.8. View of Tawi Beduwa Shwaiba, site TBS-B.

Glass vessels were quite rare at the site, and other finds included only a few glass bangles and bronze rings. A single coin was also recovered, a Bahraini bronze coin dating to 1965.

The site appears to be an Islamic campsite, perhaps utilised by one family or several families. A local informant told us several interesting

pieces of information. Namely, that ‘water could once be found at a depth of only 2m below the interdunal hollow’; that date palms had once existed in this location; that the Manasir tribe had lived here approximately 100–130 years ago; and that the women had stayed here, whilst the men went to the coast during the winter time for fishing and pearling.

The test trenches excavated at Muray site 1 (Bad Al Muray) revealed that archaeological remains were only scattered directly on the surface, no stratified remains being recovered from buried layers. The profiles of the excavated trenches demonstrated a series of thin natural windblown accumulated layers beneath the surface finds (Fig. 17.6).

Table 17.1 Fishes represented at Muray and Tawi Beduwa Shwaiba

<i>Taxon</i>	<i>Common Name</i>	<i>Muray 1</i>	<i>Muray 2</i>	<i>Tawi Beduwa Shwaiba</i>
Chondrichthyes				
Indet	Shark/Ray/Skate	4	0	2
Belonidae				
Indet	Needlefish	0	1	0
Serranidae				
<i>Epinephelus</i> sp.	Grouper	5	1	52
Lethrinidae				
<i>Lethrinus</i> sp.	Emperor	0	0	1
Sparidae				
<i>Acanthopagrus</i> sp.	Seabream	10	15	8
<i>Argyrops Spinifer</i>	King Soldier-bream	4	3	2
<i>Rhabdosargus</i> sp.	Haffara Seabream	12	3	5
Indet		11	5	6
Scombridae				
<i>Thunnus</i> sp.	Tuna	2	0	1
Osteoichthyes				
Indet		3	11	19
Total		51	39	96

Murray site 2

The site was first discovered by a local man in December 2007. The joint Japanese–ADACH team then surveyed the site on 29 April and 6 May 2008. Murray site 2 is located in similar terrain to Murray site 1. A scatter of ceramics, fish bones, camel and goat bones, approximately 26m north–south by 10m east–west, was identified on the surface of a narrow interdunal area amidst sand dunes (Fig. 17.7). The height of the surrounding sand dunes are approximately 10m above the level of the interdunal area.

There were small scattered fragments of earthenware cooking pots, basins and jars, as well as animal bones, visible on the surface. Small fish bones are scattered with grey ash on the surface of the sand. The scatter of earthenware ceramics is relatively small, as are the quantity of Chinese ceramic cups and dishes. Overall, the ceramic assemblage appears to be consistent with the occupation of the site being during the Late Islamic period, i.e. during the 19th–20th centuries. The site appears to be a short-term campsite used by a small group of people, perhaps a family.

Tawi Beduwa Shwaiba

The site of Tawi Beduwa Shwaiba was first noted in 1992 and then an initial survey of the site was carried out in 1997 (see above for details). The joint Japanese–ADACH team re-surveyed Tawi Beduwa Shwaiba in early May 2008. Four different areas were identified within the site, designated as areas A, B, C and D.



Fig. 17.9. Close-up view of the occupation deposits at Tawi Beduwa Shwaiba, site TBS-B.

Areas A and B were two scatters of ceramics and animal bones, about 25m apart, recorded towards the south-western part of the site (Fig. 17.8). Area A consisted of a surface of scatter of ceramics and dense fish bones, measuring 12m north–south by 9m east–west, spread across a flat area located besides a low sand dune about 7m high to the north.

Area B was a similar scatter of potsherds, mammalian and fish bones located about 50m to the north-east of area A (Fig. 17.9). The scatter was spread over an area measuring 20m north–south by 50m east–west, and was situated on the gently sloping side of the northern dune and its adjacent interdunal area. To the north of the scatter lay a high sand dune approximately 10–15m in height.

Area C was located about 200m east of area B beyond one large sand dune. This area was subsequently subdivided into three sub-

areas, designated as TBS-C1, TBS-C2 and TBS-C3. These three scatters of ceramics and fish bones were all located amongst an area of low sand dunes approximately 10–15m in height. Scatter TBS-C1 was located at the northern end of the cluster and measured about 9m north–south by 10m east–west. Scatter TBS-C2 was just 4m or so south of TBS-C1 and measured about 10m north–south by 12m east–west. Finally, scatter TBS-C3 was located at the southern end of the cluster, about 20m south-west of TBS-C2, and measured 9m north–south by 10m east–west.

Area D consisted of a rather sparse scatter of animal bones and sporadic ceramics, measuring 10m north–south by 30m east–west, located at the northern end of the site.

Table 17.2 Fish anatomical elements represented at Muray and Tawi Beduwa Shwaiba

	<i>Epinephelus</i> sp.	<i>Lethrinus</i> sp.	<i>Acanthopagrus</i> sp.	<i>Argyrops</i> <i>spinifer</i>	<i>Rhabdosargus</i> sp.	<i>Thunnus</i> sp.	Indet	Total
<i>MURAY SITE 1</i>	5	0	10	4	12	2	18	51
Dentary	1		2	4	8		1	16
Maxilla			2		3			5
Premaxilla			6		1		4	11
Quadrate	1							1
Cleithrum	1							1
Spine frag							1	1
1st Vertebra							2	2
Abdominal vertebra	1						1	2
Caudal vertebra							2	2
Penultimate vertebra						1		1
Vertebra	1					1	6	8
Fragment							1	1
<i>MURAY SITE 2</i>	1	0	15	3	3	0	11	33
Neurocranium			1					1
Dentary				3	1		1	5
Maxilla					1			1
Premaxilla			6					6
Quadrate							1	1
Hyomandibular			1					1
Cleithrum	1		2					3
Opercula			3		1		2	6
Otolith			2					2
Spine frag							1	1
Scale							2	2
Abdominal vertebra							1	1
Caudal vertebra							1	1
Vertebra							1	1
Fragment							1	1
<i>TAWI BEDUWA SHWAIBA</i>	52	1	8	2	5	1	19	88
Vomer	2							2
Neurocranium	2							2
Articular	5							5
Dentary	8	1	1	2	2			14
Maxilla							1	1
Premaxilla	4		5		3			12
Quadrate	1		1					2
Opercular							1	1
Preopercular	1							1
Cleithrum	3							3
First vertebra			1				1	2
Abdominal vertebra	13						1	14
Caudal vertebra	13					1	4	18
Vertebra							2	2
Fragment							9	9

Overall, the analysis of the ceramic assemblage from Tawi Beduwa Shwaiba indicates that the site was occupied during the Late Islamic

period, some time between the latter half of the 18th century and the mid-20th century. The site appears to be a large campsite of nomadic families and may have been used as an important way station on the transportation route between Abu Dhabi and Liwa.

Fish Bones

A total of 135 fish bones were examined from the three sites (Table 17.1). Fishes represented included some sort of shark, ray or skate, represented by indeterminate vertebra fragments, needlefish (Belonidae), grouper (Serranidae: *Epinephelus* sp.), the fish known locally in Arabic as ‘hamoor’, emperors (Lethrinidae: *Lethrinus* sp.), known locally in Arabic as ‘shaeri’, several types of seabream (Sparidae), including the genera *Acanthopagrus* and *Rhabdosargus*, as well as the king soldierbream (*Argyrops spinifer*), known locally in Arabic as ‘kofar’. These fish were in most cases represented by both cranial and vertebral elements (Table 17.2). This indicates that the majority of the fish were arriving to the site in a relatively complete whole state, inferring that the whole fish was salted and/or dried and brought to the site. Based on the relative size of diagnostic cranial fragments it was possible to reconstruct the size of these fish, based on relative comparisons with the primary author’s personal osteological fishes reference collection of fishes collected in the region. The majority of these fish were medium in size, being from fishes 20–30cm in length (Table 17.3). There were some larger fish, in some cases up to around 70cm in size, but these were all examples of groupers (‘hamoor’). Comparison of the relative size of fish vertebrae retrieved from all three sites showed a similar pattern of medium-sized fishes with the only larger fish represented being either groupers or tuna (Table 17.4). The site of Tawi Beduwa Shwaiba had a greater number of bones from larger groupers than at the two Muray sites. This difference may however be simply an effect of sample size.

Table 17.3 Size of the fishes at Muray and Tawi Beduwa Shwaiba, based on size reconstruction from diagnostic elements

SITE	10–20 cm	20–30 cm	30–40 cm	40–50 cm	50–60 cm	60–70 cm
MURAY 1						
<i>Epinephelus</i> sp.				1		2
<i>Acanthopagrus</i> sp.	2	8				
<i>Argyrops spinifer</i>		4				
<i>Rhabdosargus</i> sp.	5	7				
MURAY 2						
<i>Epinephelus</i> sp.						1
<i>Acanthopagrus</i> sp.		14	1			
<i>Argyrops spinifer</i>		3				
<i>Rhabdosargus</i> sp.		3				
TAWI BEDUWA SHWAIBA						
<i>Epinephelus</i> sp.			1	8	5	10
<i>Lethrinus</i> sp.			1			
<i>Acanthopagrus</i> sp.		7				
<i>Argyrops spinifer</i>		1	1			
<i>Rhabdosargus</i> sp.		5				

Table 17.4. Relative size of the fish vertebrae collected from Muray and Tawi Beduwa Shwaiba. Measurements taken in mm on the maximum diameter of the centrum of each vertebra

Size (mm)	MURAY1				MURAY2		TAWI BEDUWA SHWAIBA			
	Chondrichthyes	Serranidae	Sparidae	Scombridae	Sparidae	Chondrichthyes	Serranidae	Sparidae	Scombridae	
5			4							
6	1		7					6		
7	1		3		2	1				
8	1				11		2			
9						1		2		
10								1		
11						1	6	1		
12		1					2			
13							5			
14		2					3			
15							5			
16				1			7			
17				1			5			
18							4			
19							6			
20							2		1	
21							1			
22							1			

Marine shells

The presence of moderate quantities of marine shells were also recorded, interspersed between the scatters of potsherds, mammal and fish bones at the three sites. These included cerithids, worm shells, cowries, murex, olive shells, Arcoidea shells, pearl oysters, rock oysters, cockles, Tellinoidea shells, as well as venus clams (Table 17.5). The range of habitats that these marine mollusca were originally collected from must have included both rocky coastal areas, as well as shallow sandy and muddy sandy areas situated along the coast. It seems likely that the majority of these marine mollusca would have been eaten by the inhabitants of these sites, although some of them may also have been a waste by-product of the manufacture of jewellery items, or may have been accidentally transported to the site,

such as is perhaps the case for the small cerithid shells.

Table 17.5 Marine shells identified at Muray and Tawi Beduwa Shwaiba

Taxon	Common name	Muray 1	Muray 2	Tawi Beduwa Shwaiba	Habitat
Cerithidae					
<i>Clypeomorus bifasciatus</i>	Creepers/ceriths			1	Intertidal on & under rocks
<i>bifasciatus</i>					
Indeterminate		1		1	
Vermetidae					
<i>Serpulorbis variabilis</i>	Worm shell			1	On rocks & flat surfaces
Cypracidae					
<i>Cypraea</i> sp.	Cowrie			3	Under rocks & coral
Muricidae					
<i>Murex</i> sp.	Murex			1	Offshore & beached in sand
Olividae					
<i>Oliva bulbosa</i>	Olive shell	2		4	Intertidal & offshore in sand
<i>Ancilla farsiana</i>	Olive shell	1		5	Intertidal & offshore in sand
Arcidae					
<i>Anadara antiquata</i>	Arcoidea	3			In muddy sand, intertidal & offshore
<i>Anadara</i> sp.	Arcoidea			2	
Pteriidae					
<i>Pinctada margaritifera</i>	Pearl oyster	2		2	Attached among rocks from lower shore & below
<i>Pinctada radiata</i>	Pearl oyster	2	1	2	Attached to rocks from lower shore & below
<i>Pinctada</i> sp.	Pearl oyster			2	
Ostreidae					
<i>Saccostrea cucullata</i>	Oyster	1			Covering rocks or in clumps in mangroves, upper middle shore
Cardiidae					
<i>Acrosterigma lacunosa</i>	Cockle	3		3	In sand, offshore
Semelidae					
<i>Ervilia</i> sp.	Tellinoidea	1			In sand, offshore
Veneridae					
<i>Circenita callipyga</i>	Venus clam	1		2	In sand and sandy mud, mud-tide levels
Total		17	1	29	

Mammal bones

The mammalian faunal remains are in general badly preserved. The loss of collagen has contributed in weakening the structure of the bones. Small bones have been preserved better than longbones. The only large mammal bones were found at Muray and these are two first phalanges of dromedary (*Camelus domedarius*) (Fig. 17.10). Caprini are the main taxonomic group represented in the assemblage (Table 17.6). Almost all the skeletal parts are present; the ones that are absent are due to taphonomic loss and/or recovery bias. The presence of the skull and mandibles indicates that animals were kept alive and that they were slaughtered at the site.

The distinction between sheep and goat is not easy on all bones. The criteria used here follow those defined by Boessneck 1969 and Clutton-Brock *et al.* 1990. Possible measurements were made on phalanges and on the more resistant parts of the body: Distal Tibia and Distal Humerus. The sheep and goat are generally young animals

with reference to the fusion of the bones (Table 17.7).

The distinction of goat and sheep

Most of the bones could be allocated to goat according to the criteria of Boessneck (1969) and Clutton-Brock *et al.* (1990) (Figs 17.11–17.14). On the humerus, the distinction between sheep and goat was also verified with the measurements of the distal trochlea following Helmer & Rocheteau (1994); the indices below 60, obtained on the two measurable specimens are fully compatible with goat measurements and morphology. If most of the bones were allocated to goat some bones had an intermediary morphology. This was also the case in Tawi Beduwa Shwaiba of two unfused hemi-frontal bones of the skull with undeveloped horn cores (Fig. 17.15). Unimproved breeds of goat bear horn cores. The interfrontal fusion of the frontal bone is reported by Baron (1986) between 5 and 7 years. On the postcranial bones the information on age of death are scarce. Only one phalanx has an unfused proximal end indicating that it was killed between 7 and 10 months.

Table 17.6 Mammal bones represented at Muray and Tawi Beduwa Shwaiba

<i>Site name</i>	<i>Element</i>	<i>Camel</i>	<i>Large herbivore/ camel-horse</i>	<i>Capra</i>	<i>Ovis cf</i>	<i>Caprini</i>	<i>Unid</i>	<i>Total</i>
Murray	Horn core			2				2
	Skull					1		1
	Maxillary					2		2
	Vc atlas					1		1
	Vc axis					3		3
	Vcd					1		1
	Coxal					4		4
	Femora					1		1
	Tibia					2		2
	Talus			2				2
	Naviculo cuboide					1		1
	Metapodial					2		2
	Phalanx 1	2		2	1	2		7
	Phalanx 2				3	1		4
	Phalanx 3			3				3
	Unidentified						11	11
Total Murray		2		9	4	22	11	47
Tawi Beduwa Shwaiba								
	Skull				2			2
	Mandible		1			2		3
	Rib					1		1
	Vc					2		2
	Vc atlas					1		1
	Vc6					1		1
	VI					1		1
	Vt					2		2
	Humerus			2		2		4
	Radius					2		2
	Metacarpal					1		1
	Coxal					1		1
	Femor			1		1		2
	Tibia					2		2
	Talus				1			1
	Metapodial			1				1
	Phalanx 1			4				4
	Phalanx 3			1				1
Total Tawi Beduwa Shwaiba		0	1	9	3	19	0	32
Total		2	1	18	7	41	11	79

Discussion

The discovery of the Mari and Tawi Beduwa Shwaiba sites confirms one of the traditional routes followed by people and their camels between Abu Dhabi and Liwa. Many such sites are now known thanks to the earlier work carried out by the Abu Dhabi Islands Archaeological Survey (King and Hellyer 2003). The types of pottery and other possessions discovered at these desert campsites shows that some of the more affluent urban classes clearly moved between Abu Dhabi and Liwa.



Fig. 17.10. Camel 1st phalanges from Muray site 2.



Fig. 17.11. Goat horncores from Muray site 1.



Fig. 17.12. Goat humeri: a. (posterior view); b. (anterior view) from Tawi Beduwa Shwaiba.

Analysis of the pottery assemblages from all these sites confirms that the date when they were occupied was during the Late Islamic period, some time between the latter half of the 18th century until the middle–end of the 20th century. A similar range of types and shapes of ceramics were found at each site, including Iranian painted glazed ware, Chinese blue-and-white, European painted and blueand-white wares, Omani brown glazed ware, as well as local earthenware vases and cooking pots.



Fig. 17.13. Goat 1st phalanges from Tawi Beduwa Shwaiba.



Fig. 17.14. Goat 3rd phalanges from Tawi Beduwa Shwaiba.

Comparable pottery assemblages are known from the Bait Bin Ati al-Darmaki at Qattara oasis and the Bin Suroor House at Al Mutaredh

oasis in Al Ain (Power & Al Kaabi in press). Similar ceramics are also found at a number of coastal sites such as Khor Kalba, Kalba, Fujairah, Khorfakkan, Madha, Dibba, Sharjah, Jumeirah, as well as the inland settlements at Masafi, Bithna, Awala and other locations (Sasaki & Sasaki 2012). Excavations at Jazirat al Hulaylah, Luluiyah and Julfar, however, have not recovered the same types of ceramics. This suggests that the period of occupation in this region of the Abu Dhabi desert was limited only to the Late Islamic period.

Why then are the early and middle Islamic occupation periods not represented in any of these desert sites? We know that numerous sites dating back to the Neolithic/Late Stone Age have been found in the deserts of Al Gharbia. Following the end of the so-called Holocene Climatic Optimum period, around 6000 years ago, there is a period of extreme aridity, marking what some authors have called the “Dark Millennium” (Uerpmann 2003) and this may be one of the reasons why we do not find any sites dating to the 4th millennium BC. It may also be a factor in explaining why do not find substantial archaeological material in the desert dating to the Bronze and Iron Ages. The few known sites in Al Gharbia are all located on the coast or on islands, where more favourable conditions may have existed for settlement and subsistence. If so, why then do we suddenly find evidence for settlement activities during the latter half of the 18th century? We know that this was a period which saw the emergence of the settlement of Abu Dhabi, the construction of Qasr Al Hosn and the Maqta watchtower, as well as the construction of a series of historic forts to safeguard water resources and date palm gardens in the oases of Liwa and Al Ain.



Fig. 17.15. Sheep skull from Tawi Beduwa Shwaiba, site TBS-C2.

A number of questions, however, still remain. The sand dunes are highly mobile in this region of Abu Dhabi. Temporary camp sites utilised on a seasonal basis may have left only ephemeral traces in the archaeological record. The rapid movement of sands within this area can easily obscure or mask the traces of earlier activities at these locations. Sites such as Tawi Beduwa Shwaiba area A may soon disappear under the shifting sands of the Abu Dhabi desert. Similarly, new evidence of occupation areas may appear as the interdunal areas change in size and form.

What do these scatters of finds deep in the desert actually represent? Were there any traces of structures associated with these pottery and animal bone scatters? Are these find scatters associated with the location of former wells? Do the larger examples of these scatters (like perhaps in the case of Tawi Beduwa Shwaiba) remain *in*

situ for longer periods of time than some of the more ephemeral find scatters, since they are located along favoured travelling routes? Did the tribe in this area come to the Tawi Beduwa Shwaiba camp site looking for pasture and water for their camels during the winter? Why were ceramics and fish bones found in such profusion at these sites?

Analysis of the fish bones discovered at these sites provides evidence of the types of dried fish that were consumed by the nomadic people, as well as which resources were imported to the oases in the interior. The fish remains recovered included bones from shark/ ray/ skate, needlefish, grouper, emperor, several types of seabream and tuna.

Marine resources exploited and transported to the interior was not only restricted to fish; marine shellfish were also recovered at these sites and would have been consumed. This demonstrates the general importance of marine resources to the nomadic people and the relations between coastal communities and those living within the desert interior. Perhaps those living on some of the major transportation/migration routes between the coast and Liwa, or who had a taste of urban life on the coast in the newly emerging settlement of Abu Dhabi, were more likely to eat fish than some of their other nomadic counterparts who spent less time in the coast and more time wandering within the desert interior.

Salted and dried fish are a valuable resource, which can be kept for many months, even within the desert. It is known that people who lived in Al Ain oasis visited the coast selling charcoal, returning with salted and dried fish (Mohammed Al Neyadi, pers. comm.). Coastal inhabitants also penetrated the desert with camels to sell dried fish. These accounts from the pre-oil era give us an idea why there are dense scatters of fish bones at some of these desert sites.

Various domestic activities clearly took place at these desert sites. Other finds recovered included stone pestles and mortars, used for milling flour and/or grinding other products, whetstones for sharpening iron knives, as well as flint fragments, used as strike-a-lights. Small chips of calcite, haematite and limestone were also noted. Small finds recovered from the survey included glass bottles and glass fragments, glass beads, as well as a few metal fragments, including a finger ring base and several coins.

Mammalian bones recovered from these sites demonstrate which animals accompanied the people as they made their seasonal migration between the coast and the interior. Mammal bones recovered from the sites included camels, sheep, goats as well as

desert hare. The domestic animals would have accompanied the people as they moved between the coast and the inland oasis, whilst the latter was probably hunted locally in the vicinity of the site. Camels would have been also used to help transport water at wells and oases.

Further research

Tawi Beduwa Shwaiba was the largest amongst the three sites examined and appears to be located on one of the regular transportation/migration routes used by migrating tribal groups between the coast and the desert interior, heading to and from the Liwa oasis. Muray was a more ephemeral nomadic desert camp site, which was perhaps less frequently utilised, judging from the relative volume of finds recovered from the sites.

Further research is clearly required to investigate further examples of such sites. It would be profitable to map the locations of known historic wells to then target new areas for future archaeological surveys in their surrounding dunes. As the sands of Al Gharbia shift year by year who knows what new secrets may be revealed in the future.

In conclusion, it is hoped that this work demonstrates the value of undertaking archaeological investigations of historical sites from the pre-oil era. The analysis of both ceramic assemblages and environmental finds can provide new insights into both the life and daily diet of pre-oil era populations in Abu Dhabi emirate.

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18. Nomads, horses and mobility: an assessment of geographic origins of Iron Age horses found at Tsengel Khairkhan and Baga Turgen Gol (Mongolian Altai) based on oxygen isotope compositions of tooth enamel

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The ephemeral nature of pastoral nomadism leaves few traces in the archaeological record with which to study the functioning of these communities. Although the Iron Age peoples of the Altai region did not build permanent settlements, they did construct kurgans (funerary barrows), which on occasion include depositions of horses. As horse teeth grow, enamel records isotope compositions related to water and food consumed during the period of its mineralization as a continuous record covering several years. This paper discusses results of a project to explore the movements and social connections of these nomadic groups through isotopic analyses of tooth enamel from horse burials excavated from first millennium BC funerary barrows. It employs the phenomenon that the oxygen isotope composition ($\delta^{18}\text{O}$) of meteoric precipitation varies geographically, and presents tooth enamel $\delta^{18}\text{O}$ values for Iron Age horses excavated from two sites in the Mongolian Altai and an assessment of differentiating between 'local' and 'non-local' values for the sites as a first step in building a framework within which to analyse the past geographical movement of the horses.

Keywords Pastoralism; Mobility; Central Asia; Iron Age; Mongolia; Horse; Oxygen isotope ratios; Tooth enamel

Introduction

Migration is frequently cited as a key feature of the later prehistoric societies of the Eurasian steppe, with two forms of practice being invoked: the regular movement of people with their herds between different environments at specific times of the year (e.g. Khazanov 1984; Koryakova & Hanks 2006), and the colonising migration of groups of people from one region to permanently settle in another (e.g. Anthony 2007; Koryakova 2002, 276; Scott *et al.* 2004). Although the development of mobile forms of pastoralism had a long trajectory in this region (Allard & Erdenebaatar 2005; Anthony 2007; Legrand, 2006), it is at the start of the 1st millennium BC, with increased evidence for mobility in the steppe, that it is often agreed that fully-fledged pastoral nomadism emerged (Koryakova & Hanks 2006; Renfrew 2002). The archaeological record also witnesses the concurrent spread of some common cultural elements throughout the steppe (e.g. Bashilov & Yablonsky 1995; Christian 1998, 124; van Geel *et al.* 2004). Within such a context, of increased mobility and of extensive long-distance interactions, the transport capabilities of the horse emerge as a vital factor. The great social importance of horses during the Iron Age is clearly visible in the rich archaeological finds of this period, in particular the multiple horse burials at high status barrows in the region (Alexeev *et al.* 2001; Čugunov *et al.* 2003; Francfort *et al.* 2000; Rudenko 1970).

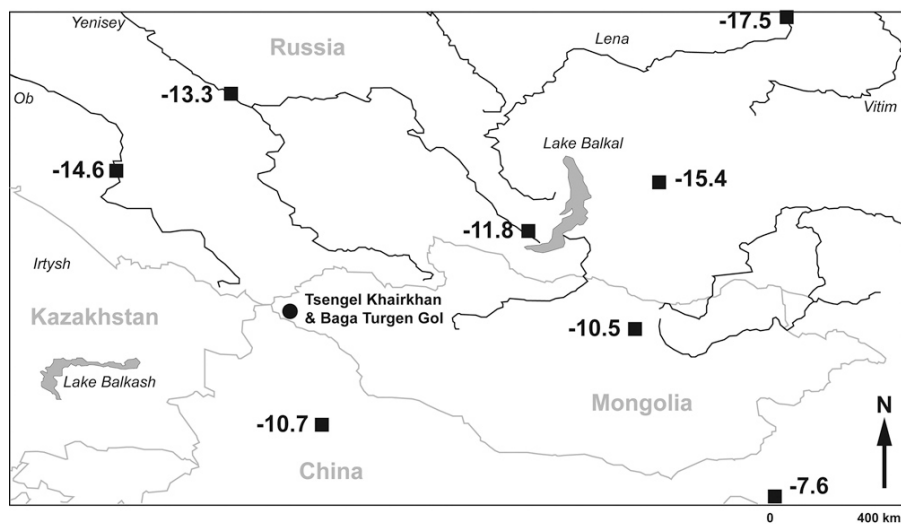


Fig. 18.1. Map showing location map of Tsengel Khairkhan and Baga Turgen Gol and modern precipitation $\delta^{18}\text{O}$ values (‰): long-term weighted means from the Global Network of Isotopes in Precipitation (GNIP) database are plotted according to the positions of the GNIP stations (black squares) (IAEA/WMO, 2006).

The available means of transport would have been a key factor in the dynamics of any colonising migration (Anthony 2007 111), and horses would have formed an essential component of nomadic lifestyles as movement to seasonal pastures would have been important for the success of subsistence strategies (Koryakova & Hanks 2006; Shnirelman *et al.* 1996; Vainshtein 1980). In contemporary and historic pastoral movement systems, distances and patterns of seasonal movements vary considerably across Central Asia, ranging from a few kilometres to over 1000 (Ferret 2009; Sneath 1999; Shnirelman *et al.* 1996). The latter distances are known from (meridional) migrations of Kazakhs in the 19th century AD across the steppe (Shnirelman *et al.* 1996). Vertical migrations of groups exploiting uplands and mountains tend to follow shorter routes. During the 1930s, for example, nomadic groups of the Sayan-Altai uplands in Tuva followed average annual migrations of 25–30km a year for a poor *aal*, and 50–60km for a rich *aal* (Vainshtein, 1980, 83–103) [an *aal* is a unit of a few households that migrated together, equivalent to the Mongol *ail* and the Kazakh *aul* (Humphrey 1980, 13)]. Some modern mobile pastoralists in the Mongolian Altai are known to cover annual migrations in excess of 200km (Foggin *et al.* 1997).

In addition to migrations, there are other possible reasons for journeys of humans with their horses, over shorter or longer distances, for example in acts of trade, hunting, conflict, and communication. There is evidence for long-distance movements of commodities in the later prehistoric steppe (e.g. Bokovenko 2004; Koryakova 2002), and horses could have been traded between communities. The movement of horses could also have occurred via gift-giving, both to the living and the dead. Ethnographic information on recent practices in Central Asia indicates that gifts of livestock to newly married couples are an important part of the marriage rite (Vainshtein 1980, 101; Shnirelman *et al.* 1996, 147–148). Horses may also have been given as sacrifices, to be buried with the deceased. Iconographic analysis of the tack worn by thirteen horses buried at the rich Iron Age kurgan excavated at Berel, in eastern Kazakhstan, indicates that they may have come from diverse and distant sources, perhaps as gifts from allied tribes (Francfort *et al.* 2000; Keyser-Tracqui *et al.* 2005). Various forms of

social conflict could also have resulted in the acquisition and movement of horses. Shnirelman *et al.* (1996, 148–149), for example, describe historic practices of horse theft amongst Kazakh nomadic peoples. Warfare is often seen as an important element of Iron Age life on the steppe, with the appearance of fullyfledged pastoral nomadism at the start of the 1st millennium BC being linked with a militaristic component in the society of the Iron Age steppe (mounted warriors) (Anthony 2007 322; Koryakova & Hanks 2006; Hanks 2002).

Despite the considerable research which has focused on the Iron Age societies and economies of Central Asia, identifying the mobility, seasonal migrations, and interactions of these groups has proven a considerable challenge. Problems in studying these cultures reside, in particular, in the mobile and ephemeral nature of nomadic occupation (Cribb 1991). The approach taken in this paper is based on measurements of isotope ratios in the tooth enamel of Iron Age horses. Mammalian tooth enamel preserves a record of dietary and environmental changes for the part of the animal's life during which the tooth was growing. Stable and radiogenic isotopes in the enamel can vary according to the locations where the animal lived while the tooth was growing, and can thus be used to study past movements (e.g. Balasse *et al.* 2002; Bendrey *et al.* 2009; Evans *et al.* 2006). This paper employs the phenomenon that the oxygen isotope composition ($\delta^{18}\text{O}$) of meteoric precipitation varies geographically (e.g. Bowen *et al.* 2005), and presents tooth enamel $\delta^{18}\text{O}$ values for Iron Age horses excavated from two sites in the Mongolian Altai (Fig. 18.1) and an assessment of differentiating between 'local' and 'non-local' values for the sites as a first step in building a framework within which to analyse the past geographical movement of the horses.



Fig. 18.2. Human and horse skeleton in tomb 12 at Baga Turgen Gol, Mongolia.

Table 18.1. Horse skeletons excavated from Baga Turgen Gol and Tsengel Khairkhan: location, age at death, and tooth/ column sampled. Ages attributed on the basis of incisor wear following Cornevin and Lesbre (1894). All horses are male

Site	Location	Horse (code)	Age (years)	Tooth / column sampled
Baga Turgen Gol	tomb 3	B3	+ 20	M ₃ /anterior
	tomb 8	B8	±4	M ₃ /central
	tomb 10	B10	+ 20	M ₃ /anterior
	tomb 11	B11A	±18	M ₃ /anterior
	tomb 11	B11B	±17	M ₃ /anterior
	tomb 12	B12	+ 20	M ₃ /central
	tomb 13	B13	±1	not sampled (too young)
Tsengel Khairkhan	tomb 1	T1	±5	M ₃ /anterior
	tomb 2	T2	±19–20	M ₃ /central
	tomb 3	T3A	2–4	M ₃ /anterior
	tomb 3	T3B	±10	M ₃ /anterior

Methods, materials and background

Study sites

This paper considers $\delta^{18}\text{O}$ values of tooth enamel from ten Iron Age horses from Mongolia. Samples were collected from lower third molar (M_3) tooth enamel of horses excavated from burial mounds at Tsengel Khairkhan and Baga Turgen Gol, two neighbouring sites that lie some 40km apart in the Altai Mountains, Mongolia (Figs. 18.1 and 18.2). The two sites are located in Bayan-Ölgiy aimag (province) in the west of the country at an elevation of a little over 2000m and date to the 'Pazyryk culture' (the 5th–3rd centuries BC) (Jordana *et al.* 2009). Tsengel Khairkhan produced four horse skeletons, all of which have been sampled. Baga Turgen Gol produced seven horses. Six of the seven horses excavated have been sampled; one horse, B13, was only ~1 year old at death, and consequently the M_3 had not yet begun to form (Table 18.1). Three of the horses – B8, T1 and T3A – died before the M_3 had fully formed [M_3 tooth enamel mineralization lasts from 21 ± 3 months to 55 ± 3 months in horses (Hoppe *et al.* 2004b)]. Further, from the time at which a tooth comes into occlusal contact it is progressively worn down (from the occlusal surface) due to contact with the opposite teeth, food, and other extraneous matter in the mouth (Levine, 1982; Kilic *et al.*, 1997), and consequently the teeth of the older animals have significantly shorter crowns present for analysis than the younger horses (Table 18.2).

Oxygen isotope compositions of horse tooth enamel

The oxygen isotope composition of meteoric precipitation ($\delta^{18}\text{O}_{\text{ppt}}$) varies widely and systematically across the globe, and can be used for determining the origin and movement of animals (Bowen *et al.* 2005; Bowen & Wilkinson 2002). This variation is controlled by Rayleigh distillation of atmospheric vapour, driven primarily by air-mass temperature which is largely dependent on latitudinal and altitudinal variations (Bowen & Wilkinson 2002). Mapping of modern oxygen isotope content of precipitation by the Global Network of Isotopes in Precipitation (GNIP) database confirms the general latitudinal gradient for the oxygen isotope composition of meteoric precipitation across the region (Fig. 18.1). The positions of the stations collecting data on the isotope content of precipitation do not allow a detailed consideration of the modern variability in precipitation $\delta^{18}\text{O}$ values at Tsengel Khairkhan and Baga Turgen Gol. However, the long-term weighted means of the GNIP stations plotted in Figure 18.1 indicate the magnitude of the variation in mean values across the region (IAEA/ WMO, 2006).

As ingested local surface waters constitute the primary source of

oxygen in the body water of a mammal, and tooth enamel bioapatite is formed in isotopic equilibrium with body water, then $\delta^{18}\text{O}$ values of tooth enamel may be used to infer $\delta^{18}\text{O}$ values of local waters (Fricke *et al.* 1998; Longinelli 1984; Luz *et al.* 1984). Horses are obligate drinkers, and their $\delta^{18}\text{O}$ values are considered to be more closely linked to drinking water values than in the case of other animals that obtain water mainly from plant food (which is enriched in $\delta^{18}\text{O}$ relative to precipitation due to evapotranspiration) (Hoppe *et al.* 2004a; 2005; Levin *et al.* 2006). Furthermore, tooth enamel bioapatite has been shown to be resistant to diagenetic changes (alterations due to post-depositional interactions between the tooth and the burial environment) (Lee-Thorp & Van der Merwe 1991; Wang & Cerling 1994; Zazzo *et al.* 2004). In a recent study, Bell *et al.* (2006) confirmed that latitudinal variation in precipitation $\delta^{18}\text{O}$ values are recorded in horse tooth enamel.

Mongolia has a continental climate of extreme cold and heat, and absolute temperatures can vary between -50°C in winter to 40°C in the summer (Pyankov *et al.* 2000). Modern records indicate seasonal temperature variation for Ulan Bator, Mongolia, of between around -30°C to 20°C , and that precipitation $\delta^{18}\text{O}$ values vary between around -30 to -4‰ (IAEA/WMO, 2006). Precipitation $\delta^{18}\text{O}$ values are positively correlated with temperature, with higher values occurring in warmer seasons and lower values in colder seasons (Fricke *et al.* 1998), and we would thus expect to see pronounced seasonal oscillations in the $\delta^{18}\text{O}$ values of sequential microsamples taken along a tooth of a Mongolian horse. As stated above, the process of mineralisation of enamel as the tooth grows preserves a record of $\delta^{18}\text{O}$ values of body water for this period of the animal's life; however, the delayed process of enamel mineralisation means that $\delta^{18}\text{O}$ values from enamel microsamples return a time averaged signal, which has the effect of attenuating the input signal in its amplitude (Balasse 2002; Hoppe *et al.* 2004b; Passey & Cerling 2002; Zazzo *et al.* 2005). The amplitude of seasonal variation in $\delta^{18}\text{O}$ values in tooth enamel will therefore be less than that seen in meteoric precipitation.

In addition, precipitation and surface waters become increasingly depleted in $\delta^{18}\text{O}$ with increasing altitude. In a compilation of studies from throughout the world, Poage and Chamberlain (2001) identify a linear relationship between elevation and the isotopic composition of precipitation. They identify an isotopic lapse rate of $\sim 2.8\text{‰}/1000\text{m}$ applicable for most regions of the world (except the Himalayas and at elevations of over 5000m). In studies of the 'altitude effect' on the isotopic composition of tropical rains in Cameroon and Bolivia,

Gonfiantini *et al.* (2001) identified isotopic lapse rates of 1.4‰ to 2.6‰/1000m altitude; while Rietti-Shati *et al.* (2000) identified no significant ‘altitude effect’ on Mt Kenya between 4200m and 5200m. Tsengel Khairkhan and Baga Turgen Gol are located at a little over 2000m in the Altai mountains, which reach a maximum of ~4000m, although not all of this range would have been exploited, for example modern mobile pastoralists in Hovd sum (district), Uvs aimag (province) follow seasonal routes moving between altitudes of ~1000m and ~2400m (Sneath 1999, 236–239). Thus temperature-related seasonal variation in precipitation $\delta^{18}\text{O}$ values (with a range of > 20‰, as discussed above) is expected to have a greater influence on recorded values in the horse tooth enamel than altitudinal movements that could have been made.

Table 18.2. Summary statistics of stable oxygen isotope measurements: minimum (min), maximum (max), and amplitude of variation (range). Two average values are given: mean-1 is the arithmetic mean; mean-2 has been calculated by first separately calculating the means of peak values (interpreted as summers) and trough values (interpreted as winters) in the isotopic data series from each tooth, then the average was taken of these two values (see text)

Horse (code)	No. samples	Distance sampled (mm)	$\delta^{18}\text{O}$ (‰)				
			min	max	range	mean-1	mean-2
B3	4	8.2	−13.2	−10.0	3.2	−11.7	−11.6
B8	8	26.4	−12.6	−10.7	1.9	−11.6	−11.7
B10	8	23.7	−12.5	−10.7	1.8	−11.5	−11.4
B11A	8	23.8	−12.0	−9.5	2.5	−11.1	−11.0
B11B	14	44.7	−14.6	−10.9	3.7	−12.8	−12.6
B12	5	14.0	−11.2	−9.3	1.9	−10.4	–
T1	15	46.6	−13.4	−10.2	3.1	−11.7	−12.0
T2	6	14.2	−15.5	−11.6	3.8	−13.5	−13.0
T3A	13	35.2	−12.4	−9.7	2.7	−11.1	−11.0
T3B	14	44.1	−14.4	−10.7	3.7	−11.9	−12.1

Comparative data and caveats

To provide an estimate of geographical variation in horse tooth enamel $\delta^{18}\text{O}$ values, a small quantity of data from other sites in the region are used to contextualise the Mongolian results. These include modern and archaeological horse M_3 tooth enamel $\delta^{18}\text{O}$ values: a modern domestic horse specimen collected in 2008 from near Tsengel Khairkhan, Mongolia; a Przewalski’s horse mandible collected in 1896

from Lake Ulungar, Xinjiang State, northwest China; and 13 horses buried at Arzhan 2, Tuva Republic, dating to the end of the 7th century BC (Čugunov *et al.* 2003; Zaitseva *et al.* 2007). Lake Ulungar is situated at an elevation of ~500m, and Arzhan 2 is at a little over 800m.

There are several caveats that must be borne in mind with the dataset. Mean $\delta^{18}\text{O}$ values are employed in the paper to provide an indication of the average environment in which the horse lived during the period of tooth formation, with which to compare to an assessment of 'local' range for the sites, from which animals of 'non-local' origin may be distinguished. The number of sites and samples analysed, and the absence of previously published comparative data for the region, limits our ability to identify geographical movements from these results. There is also uncertainty over the locations at which the horses had lived: we know where they were excavated from, but do not have details of where they had lived. Further, inter-annual temperature variations could create differences in $\delta^{18}\text{O}$ values between teeth and inter-individual variation between horses due to differences in ingested water from plants and individual metabolism could affect the variability of the $\delta^{18}\text{O}$ values (Hoppe *et al.* 2004a).

Analytical methods

Dental cementum was removed on one of the columns of each M_3 using a tungsten drill bit in order to access the enamel. A series of enamel samples was then taken along each crown, in a sequence perpendicular to the growth axis of the column of the tooth, using a diamond-encrusted drill bit. Each sample consisted of a horizontal band (~1mm wide and 3–5mm long) through the depth of the enamel.

Samples were taken from the buccal side of the M_3 anterior column, except in cases where this column was damaged in which case they were taken from the central column. Positions of the samples on the crown were measured from the most apical part of the enamel on the specimens, at the junction between the enamel and the root. For teeth in which the root was absent – those from the younger horses – the sample positions were measured from the first drilled sample adjacent to the maturing enamel.

After a protocol defined in Balasse *et al.* (2002), the pretreatment of the sampled enamel powder included: treatment with sodium hypochlorite (NaOCl , 2–3%, 0.1ml/mg) for 24 hours to remove organic matter; then with 0.1 M acetic acid for 4 hours (0.1ml/mg) to remove exogenous carbonate.

Bioapatite samples weighing around 560–640 μ g were reacted with 100% phosphoric acid at 70°C in individual vessels in an automated cryogenic distillation system (Kiel IV device) interfaced with a Delta V Advantage isotope ratio mass spectrometer. Over the period of analysis of the bioapatite samples from Tsengel Khairkhan and Baga Turgen Gol, the analytical precision for $\delta^{18}\text{O}$ estimated from 65 analyses of the laboratory internal carbonate standard (Marbre LM, normalised on the international standard NBS19) is 0.06‰ (1 σ). All $\delta^{18}\text{O}$ values are expressed versus VPDB.

Results and discussion

Oxygen isotope compositions

In total, 95 serial enamel samples were obtained from the teeth of the ten horses excavated from Baga Turgen Gol and Tsengel Khairkhan. The $\delta^{18}\text{O}$ values measured in the horse tooth enamel vary from –15.5‰ to –9.3‰ (Table 18.2). The amplitude of variation within a single tooth is between 1.8‰ and 3.8‰. The amplitude of variation for precipitation $\delta^{18}\text{O}$ values quoted above is 26‰ (for modern Ulan Bator), and thus the enamel values can be seen to be significantly attenuated relative to likely precipitation values (see discussion above and Balasse 2002; Hoppe *et al.* 2004b; Passey & Cerling 2002; Zazzo *et al.* 2005).

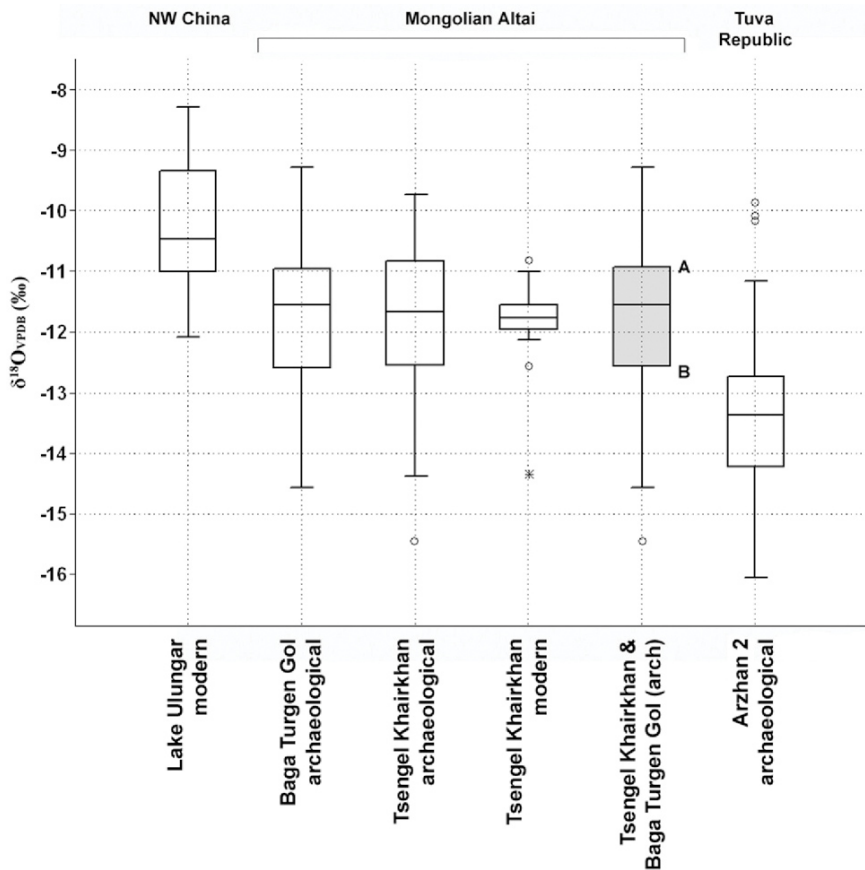


Fig.18.3. Box plots of $\delta^{18}\text{O}_{\text{VPDB}}$ values of horse tooth enamel from certain sites in Central Asia: data sets described in Figure 18.5, and site locations shown in Figure 18.1. The box plots divide a distribution according to the inter-quartile range, with the box containing 50% of the values. Possible outliers are marked by circles, probable outliers by asterisks. 'A' and 'B' mark the upper and lower limits of the central 50% of the distribution of values from the Mongolian archaeological samples, which includes both Baga Turgen Gol and Tsengel Khaikhan plotted together (greyed box).

Geographical variation in oxygen isotope compositions of horse tooth enamel

To provide an assessment of geographical variation in oxygen isotope composition of horse tooth enamel we present a comparison of the range and distribution of the $\delta^{18}\text{O}$ values from the Mongolian archaeological horse tooth enamel against some other Central Asian samples (described above) from modern Lake Ulungar (China), modern Tsengel Khaikhan (Mongolia) and archaeological Arzhan 2 (Tuva) (Fig. 18.3 and Table 18.3). The locations of these sites are

shown in Figure 18.4. Figure 18.3 presents the data in the form of box plots: this divides the distribution of values into the interquartile range and identifies possible outliers (circles) and probable outliers (asterisks). Relating the $\delta^{18}\text{O}$ values to the relative geographical locations of the sites (Figs. 15.3 & 18.4) confirms that the $\delta^{18}\text{O}$ values recorded in Central Asian horse tooth enamel of the region vary according to a large-scale latitudinal gradient (Bell *et al.* 2006; Bowen *et al.* 2005), as seen in the modern precipitation values (Fig. 18.4).

Table 18.3. Samples analysed to provide data used in Table 18.2

<i>Location</i>	<i>Site</i>	<i>No. horses</i>	<i>No. samples</i>
NW China modern	Lake Ulungar	1	12
Mongolian archaeological	Baga Turgan Gol and Tsengel Khairkhan	10	95
Mongolian modern	Tsengel Khairkhan	1	13
Tuva archaeological	Arzhan 2	13	128

Modern patterns in precipitation values may differ from ancient ones and thus cannot themselves be used to define variation across the study area for periods in the past. However, the consistency between the regional geographical variation of the tooth enamel values and modern precipitation in terms of both direction and magnitude of variation supports the premise that the $\delta^{18}\text{O}$ values of horse tooth enamel can be used to identify longdistance movements (*sensu* Bell *et al.* 2006).

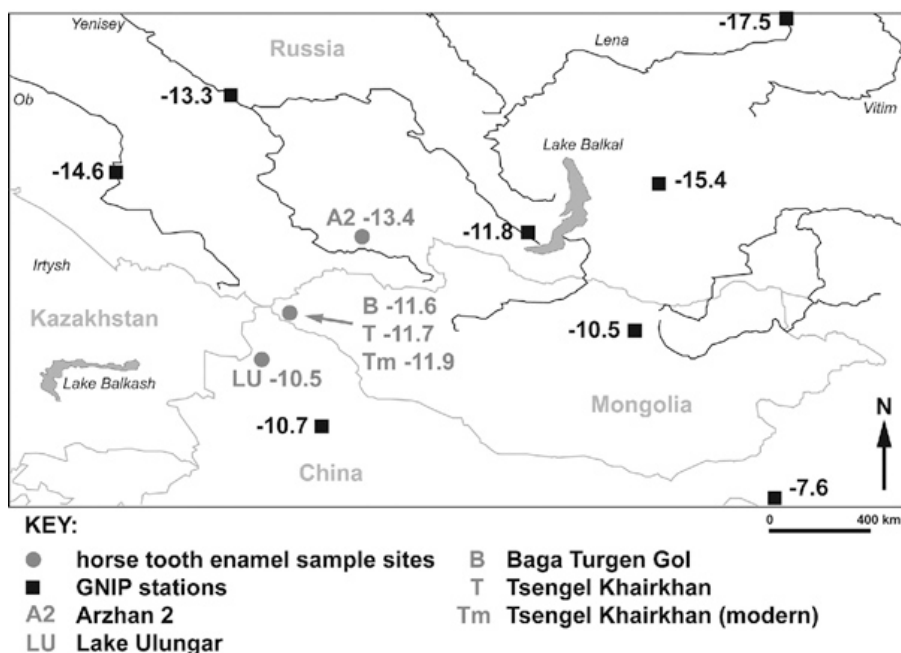


Fig. 18.4. Map showing median of the horse tooth enamel values (‰) from each of the sample sites plotted for comparison with the modern precipitation $\delta^{18}\text{O}$ values (‰) (Fig. 18.1): long-term weighted means from the Global Network of Isotopes in Precipitation (GNIP) database are plotted according to the position of the GNIP stations (IAEA/WMO, 2006).

Are the Tsengel Khairkhan and Baga Turgen Gol ‘local’ or ‘non-local’ horses?

In order to identify long-distance movements of horses, and consider the question of whether the Tsengel Khairkhan and Baga Turgen Gol horses are ‘local’ or ‘non-local’, we shall: first, calculate a mean $\delta^{18}\text{O}$ value for each tooth, in the assumption that this reflects the averaged intake of oxygen during the period of mineralisation sampled [see Hoppe and Koch (2006) and Evans *et al.* (2006)]; second, estimate a ‘local’ range for Tsengel Khairkhan and Baga Turgen Gol, to which we can compare the individual horse mean values.

MEAN $\delta^{18}\text{O}$ VALUES FOR EACH TOOTH

In taking the mean $\delta^{18}\text{O}$ value from each tooth we are combining the values recorded from throughout the period of enamel mineralisation to produce a measure of the averaged intake of oxygen, and so are not considering the movements between the different locations during any seasonal nomadic migration. The length of each tooth sampled varies due to the ages of the horses (Tables 18.1 & 18.2) and represents

different quantities of time, and we cannot thus use the arithmetic means (Table 18.2, mean-1) of each tooth dataset to calculate the averaged intake of oxygen. Rather, the average value for each tooth has been calculated in the following way. First, the means of peak values (interpreted as summers) and trough values (interpreted as winters) were calculated separately; then an overall tooth mean was calculated from the means of the peaks and the troughs (see Table 18.2, mean-2).

The adjusted means (mean-2) of the Mongolian horses are plotted in Figure 18.5. Horses B8, T1 and T3A were slaughtered during the period of formation of the M₃ (i.e. before the root had developed), and the values recorded in these teeth represent those of the regions where the horses lived in the months prior to their deaths. The consistency of these mean values and their agreement with the modern horse data from Tsengel Khairkhan (Figs 18.4 & 18.5) support the interpretation that these three horses were living in the region of the excavated tombs at the time of their deaths, and that these horses were thus 'local'.

IDENTIFYING A 'LOCAL' RANGE OF $\delta^{18}\text{O}$ VALUES?

The calculated mean values have a range of $\sim 3\text{‰}$ (Fig. 18.5). Horse B12 only produced a short data sequence from the M₃ consisting of a single 'trough' (interpreted as a winter signal). As it does not show a full seasonal cycle, no mean could be calculated, although its position is estimated in Figure 18.5. Exclusion of the data from horse B12 would give a range of 2‰ for the other nine horses.

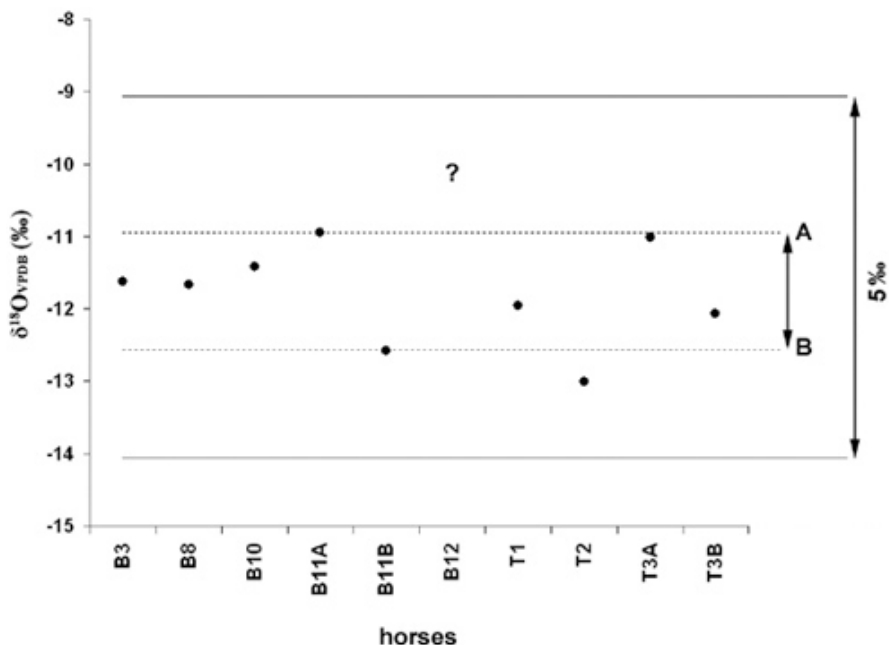


Fig. 18.5. Mean $\delta^{18}\text{O}_{\text{VPDB}}$ value for each horse M_3 from Baga Turgen Gol and Tsengel Khairkhan (mean-2 from Table 18.2). Dotted-lines 'A' and 'B' mark the limits of the central 50% of the distribution of values from the Mongolian archaeological samples (from Fig. 18.3). Solid lines mark a range of 5‰ centred on the median of the Mongolian archaeological values.

The range of mean $\delta^{18}\text{O}$ values for the Mongolian horses is relatively small when compared to other published modern equid isotopic values. Hoppe *et al.* (2004a) demonstrated that in desert horses $\delta^{18}\text{O}$ values can vary by $>6.5\text{‰}$, although the extreme conditions of such arid environments may produce large fractionations among environmental sources and among different individuals. Hoppe *et al.* (2005) calculate a range of 5‰ for $\delta^{18}\text{O}$ values for horses in a single feral population in a temperate climate from the barrier island of Shackleford Banks, which lies off the coast of North Carolina (USA). Such variation is confirmed by Wang *et al.* (2008), who found a maximum range of 5.2‰ for horses living at high altitudes on the Tibetan plateau (at Gyirong, 4100m above sea level).

To distinguish between 'local' and 'non-local' horses it would be necessary to set limits for what is considered a 'local' range. If we assume a 5‰ range, as that which would be expected to be seen in a single population living in one area [following Hoppe *et al.* (2005) and Wang *et al.* (2008)], then it would follow that only mean values outside this range could be suggested as being 'non-local'. A 5‰ range

is plotted in [Figure 18.5](#) for the Mongolian horses, centred on the median value (-11.56‰) from the Mongolian archaeological values ([Fig. 18.3](#)). Above, we argue that the data from horses B8, T1 and T3A are those that can most clearly be interpreted as ‘local’ from the two sites: the arithmetic mean for the data from these three horses is -11.55‰ , which supports the selection of the overall median value as the centre of the local range. Using the 5‰ range to define the distribution of expected $\delta^{18}\text{O}$ mean values in single populations, all ten horses would be interpreted as being ‘local’ ([Fig. 18.5](#)). Indeed, this range also covers the great majority of the enamel $\delta^{18}\text{O}$ values recovered from both Arzhan 2 and Lake Ulungar ([Fig. 18.3](#)), and would identify all as ‘local’. This would thus not allow differentiation of origins of horses from sites across this geographic distance (in this case ~ 700 km from Lake Ulungar to Arzhan 2); although it would be possible to identify horses originating from outside this area.

The narrower range of the Mongolian horse $\delta^{18}\text{O}$ mean values than those animals in the studies of Hoppe *et al.* (2005) and Wang *et al.* (2008), however, raises the question whether the modern horses from these other climatic regions provide appropriate comparative data for the horses and the environment of the Mongolian Altai. For example, as stated by Hoppe *et al.* (2005) different water sources and feeding environments could contribute to the variability of the $\delta^{18}\text{O}$ values of the Shackleford Banks horses, as might sampling error if some of the bulk samples represent less than a year of growth. Wang *et al.* (2008) do not publish details of the life-histories of their horses: they have sample collection locations, and it would seem to be (at least) possible that animals may have moved within the region. In contrast, Shackleford Banks is an island of 12km^2 , and the geographic origins of the horses in the study by Hoppe *et al.* (2005) can be known with certainty.

Without further modern horse tooth enamel data from the region it will not be possible to definitively propose a more appropriate ‘local’ range for Tsengel Khairkhan and Baga Turgen Gol. However, consideration of the archaeological data suggests that: 1) the ‘local’ ranges of means, for a population living in a single area, may be less than 5‰ [the Arzhan 2 data presents a similar range and distribution to that seen in the Mongolian data ([Fig. 18.3](#))]; 2) it should be possible to distinguish between horses whose geographic origins are separated by several hundred kilometres – the Mongolian and Tuvan (Arzhan 2) sites are situated $\sim 500\text{km}$ apart and it can be seen that the central 50% of the distributions of the archaeological tooth enamel

$\delta^{18}\text{O}$ values from the two areas have a distinct range (Fig. 18.3). Assuming that precipitation $\delta^{18}\text{O}$ values change gradually and continuously over the region, it is expected that it would be increasingly difficult to identify movements as the distances between sites is reduced, i.e. the shorter the distance between two sites, the more the ranges of 'local' values will overlap. Tsengel Khaikhan and Baga Turgen Gol, for example, are ~40 km apart, and the ranges of $\delta^{18}\text{O}$ values are almost identical.

If we compare the upper and lower limits of the central 50% of the Mongolian archaeological data to the individual horse means, it can be seen that all but two (horses T2 and B12) plot within these limits (Fig. 18.5). Relatively short isotopic sequences were derived from these two animals – they have short crown heights due to their advanced ages at death (Table 18.2) – which along with the speculative nature of the limits set means that these two horses cannot be identified as 'non-local' ('local' limits may in fact lie somewhere between the two ranges illustrated in Fig. 18.5). However, it can be concluded that all the Mongolian horses, with the possible exception of B12 and T2, exhibit results consistent with having lived in the locality of Tsengel Khaikhan and Baga Turgen Gol during the period of M₃ formation.

Conclusions

This paper represents a first step in building a framework within which to consider the movements of horses in the study area. It considers mean oxygen isotope compositions of tooth enamel from horses buried as part of the funerary rites for Iron Age people in the Mongolian Altai, within the context of a number of modern and archaeological horse tooth enamel $\delta^{18}\text{O}$ values and modern oxygen isotope composition of meteoric precipitation for the region.

The horse tooth enamel values from the sites studied vary with latitude, and agree in terms of the direction and magnitude of changes with the pattern of mean $\delta^{18}\text{O}$ values of modern precipitation. The range of mean $\delta^{18}\text{O}$ values from the Tsengel Khaikhan and Baga Turgen Gol horses is relatively small compared to the ranges (~5‰) of isotopic values demonstrated for modern horse populations from an island site in the USA (Hoppe *et al.* 2004a; 2005) and at high altitudes on the Tibetan Plateau (Wang *et al.* 2008). It is suggested that these horses are not appropriate comparative populations for horses in the environment of the Mongolian Altai, that mean $\delta^{18}\text{O}$ values from single Mongolian populations will have smaller ranges than this, and that with the collection of a greater quantity of appropriate modern

control data from across the region it will be possible to more accurately define 'local' limits for particular sites. We conclude, on the basis of the evidence to hand, that all the Mongolian horses, with the possible exception of two (B12 and T2), lived in the locality of Tsengel Khaikhan and Baga Turgen Gol during the period of (sampled) M₃ enamel formation.

Acknowledgements

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19. Zooarchaeological evidence for pastoralism in the Early Transcaucasian Culture

Jennifer J. Piro and Pam J. Crabtree

The papers presents the Early Transcaucasian Culture complex (ETC) subsistence economy during the 4th millennium BC based on the zooarchaeological evidence from four sites: Sos Höyük in northeastern Anatolia, Mokhra Blur and Gegharot in Armenia, and Godin Tepe in west-central Iran. ETC sites appear to be influenced not simply by ecological conditions, but by a range of social, economic, political, and cultural factors with varying degrees of archaeological visibility. This study indicates the emphasis on highly mobile forms of pastoralism both as a defining feature and as a mechanism for the creation and spread of the Early Transcaucasian Culture must be reconsidered.

Keywords Early Transcaucasian Culture complex, 4th millennium, pastoralism, Anatolia, Armenia, Iran

Introduction

The Early Transcaucasian Culture complex (ETC) emerged during the mid-4th millennium BC and later spread throughout the southern Caucasus and its adjacent regions. While the architecture and material culture from ETC sites have been well documented, little is known about the pastoral activities of these communities, particularly in terms of herding goals and strategies. Many researchers have suggested that mobile forms of pastoralism likely characterised the ETC subsistence economy, but the nature and extent of this mobility is much debated, ranging from long-distance seasonal transhumance (Kushnareva 1997, 194), to increasing mobility over time (Kushnareva

1997, 208, 230), to alternating forms of nomadisation and permanent settlement (Cribb 1991, 221), to the varying role of nomadic elements in the development of ETC communities (Sagona 1993, 453–454). However, the notion that mobile pastoralism figured prominently in the ETC is problematic for two reasons. First, we know little about ETC pastoral practices from their primary source, animal bone remains, since detailed faunal reports are largely unavailable or unpublished (Kohl 2007, 95; Sagona 1993, 453). Second, our current understanding of ETC pastoral activities is largely inferred from the portability of material culture and the impermanent or composite nature of dwelling forms, which resemble those used by contemporary nomadic groups (Burney & Lang 1971, 57; Cribb 1991, 221; Kiguradze & Sagona 2003; Sagona 1993; Whallon & Kantman 1969, 103). The rapid spread of the ETC horizon during the 3rd millennium BC is assumed to be linked, in part, to the seasonal movement of ETC populations in search of pasturage for their flocks (Kohl 1992, 122; Rothman 2003, 109).

Recent studies of excavated faunal remains provide new insight into the role of mobile pastoralism in the Early Transcaucasian Culture (cf. Bartosiewicz 1998; Bökönyi 1983; Crabtree 2011; Howell-Meurs 2001a; 2001b; Monahan 2005; Piro 2008; 2009). Although the existing dataset is still quite small, we can begin to test the premise that the economic base of ETC communities rested primarily on mobile pastoralism, and furthermore, that such mobility helped stimulate the migrations of ETC populations into neighboring regions. This paper presents zooarchaeological evidence from four ETC sites (Figs. 19.1 & 19.2): Sos Höyük in northeastern Anatolia, Mokhra Blur and Gegharot in Armenia, and Godin Tepe in west-central Iran.¹



Fig. 19.1. Map of Sos Höyük, Mokhra Blur, and Gegharot in the region (created by Chandra Jayasuriya)

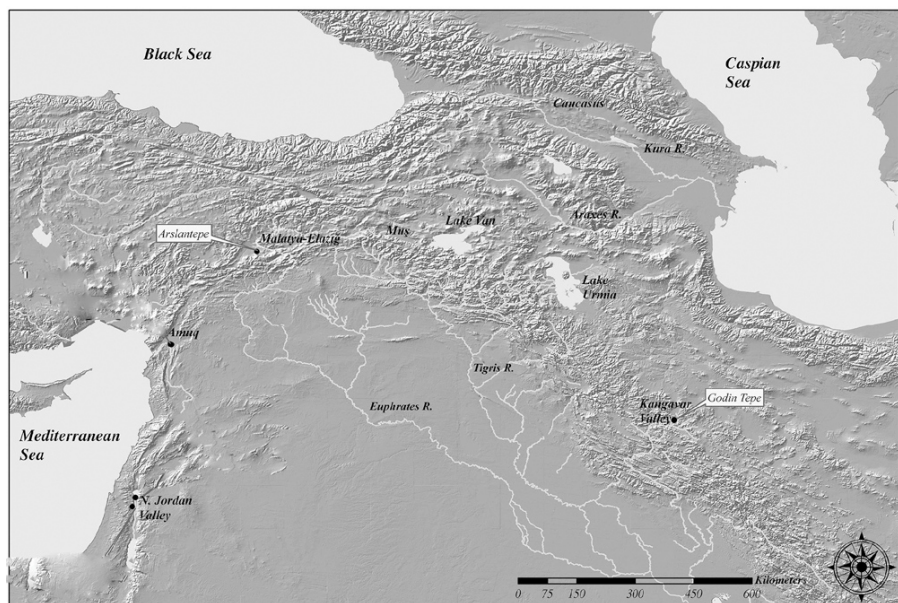


Fig. 19.2. Map of Godin Tepe in the region (adapted from a map created by Stephen Batiuk)

Sos Höyük faunal assemblage

The archaeological site of Sos Höyük is located in the modern village of Yiğittaşı, approximately 24km east of the city of Erzurum in the highlands of northeastern Turkey (1800m a.s.l.). Both the Late Chalcolithic and Early Bronze Age periods at the site yielded architectural forms and artefacts that resemble the ETC horizon style: round and rectangular houses constructed from wattle and daub or mud brick; figured hearth supports; black and red burnished wares and other related suites of ceramics; tools manufactured from bone, obsidian, and arsenical bronze; and horned animal figurines (Sagona *et al.* 1995; 1996; 1997; Sagona & Erkmén 1998; Sagona & Sagona 2000). At present, Sos is atypical of ETC sites due to its Middle Bronze Age settlement phase – rarely found elsewhere in Transcaucasia – and the continued use of the ETC ceramic suite, along with new stylistic and technical innovations, throughout this time period.

To investigate the nature of pastoral activities at Sos, approximately 16,000 faunal specimens were analysed from archaeological contexts containing ETC materials.² These contexts were chronologically divided into Late Chalcolithic (3500/3300–3000 cal BC), Early Bronze I (3000–2800 cal BC), Early Bronze II–III (2800–2200 cal BC), and Middle Bronze Age (2000–1500 cal BC) – almost 2000 years of the occupational sequence at the site (Sagona 2000). The vast majority of the faunal assemblage in each phase at Sos consists of domesticated species: caprines are the most abundant followed by cattle, while pigs, horses, and dogs are very rarely represented (Fig. 19.3 and Table 19.1). Wild animals constitute less than 8% of the sample in each period. Worth noting is the richness in species diversity found in the later Early Bronze Age, which yielded red deer, a variety of birds and small mammals, and the wild versions of cattle, sheep, goats, and pigs.³

Figure 19.4 presents the species ratios of the main domesticates from the Late Chalcolithic through the Middle Bronze Age at Sos. Overall, the relative abundance of cattle, caprines, and pigs is largely comparable between the Late Chalcolithic and Early Bronze I phases. During the later Early Bronze Age, however, the proportion of cattle rises, while that of caprines declines by approximately 13%. This reverses in the Middle Bronze Age as the number of cattle decreases and caprines once again dominate the assemblage. These fluctuations in the ratio of cattle to caprines over time are to some extent related to biases inherent to the NISP method of quantification. However, the analysis of specimen fragmentation rates in the EBII–III sample indicates that the sizeable proportion of cattle is not due to high levels

of fragmentation (Piro 2009, 176–177, 184–185). Thus, while sheep and goats are the predominant species in each phase, cattle appear to have a particularly strong secondary role in terms of relative abundance during the later Early Bronze Age.

Ovis/capra: mortality data

Caprine herding goals and strategies are the focus of this section due to the substantial quantity of sheep and goat remains in the assemblage. Mortality profiles were constructed from tooth eruption and wear using mandibles, the lower 4th deciduous premolar, and the lower 3rd molar. Due to the limited dental data available for this study, a combined caprine sample was analysed from each phase (Fig. 18.5).⁴ Findings indicate that caprine survivorship patterns are highly comparable throughout the Early Transcaucasian period at the site (Kolmogorov-Smirnov two-sample test, $p > 0.05$). In each phase, a substantial proportion of animals were slaughtered between 1 and 3 years of age – a period that includes adolescence and early adulthood. This mortality pattern suggests that animals, perhaps subadult males, were killed for meat before reaching full maturity. A much smaller percentage of the herd, probably females, survived well into old age, provided that they continued to breed and provide milk. In order to infer production goals and management strategies, the caprine tooth eruption and wear data were then compared to Payne's (1973) and Redding's (1981; 1984) idealised kill-off patterns. The resulting survivorship pattern shows a close fit with Redding's (1981) herd security model and Payne's (1973) meat model in each phase (Kolmogorov-Smirnov two-sample test, $p > 0.05$) (Fig. 19.5). Furthermore, the survivorship curves point to a stability and resilience in herd management practices throughout the Early Transcaucasian period at the site.

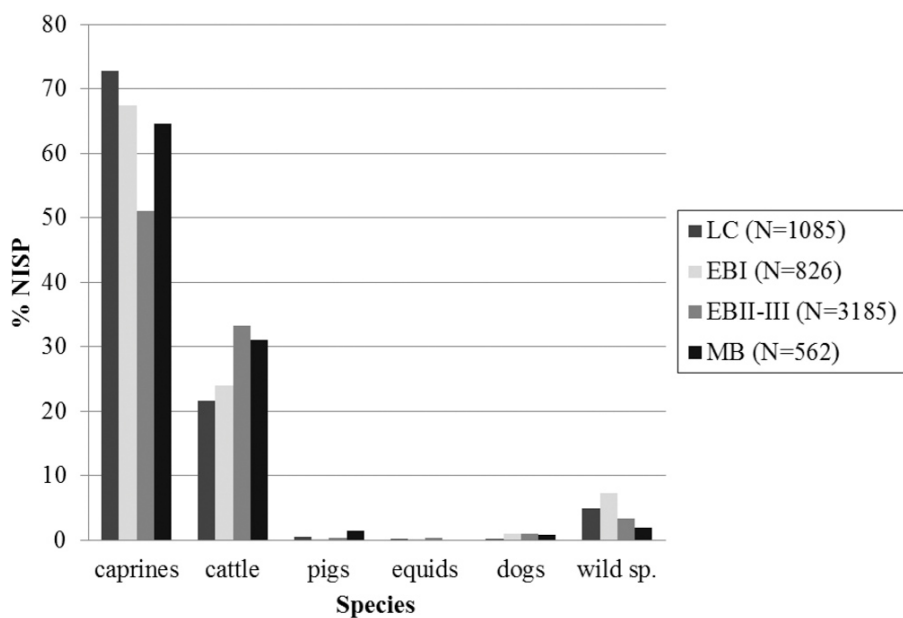


Fig. 19.3. Species representation at Sos Höyük. EBII–III phase includes data analysed by Howell-Meurs (2001b, 117)

Table 19.1. Number of Identified Specimens (NISIP) assigned to genus from Sos

SPECIES	LC	%	EBI	%	EBII-III	%	MB	%
Domesticates								
<i>Bos taurus</i> (cow)	234	21.6	199	24.1	181	25.6	175	31.1
<i>Ovis/Capra</i> (sheep/goat)	789	72.7	560	67.8	476	67.2	363	64.6
including:								
<i>Ovis aries</i> (sheep)	211		150		124		109	
<i>Capra hircus</i> (goat)	54		36		53		20	
<i>Sus scrofa dom.</i> (pig)	5	0.5	2	0.2	2	0.3	8	1.4
<i>Equus sp.</i> (horse)	1	0.1	2	0.2	1	0.1	0	0.0
<i>Canis familiaris</i> (dog)	3	0.3	8	1.0	10	1.4	5	0.9
Subtotal	1032	95.1	771	93.3	670	94.6	551	98.0
Wild Species								
<i>Capreolus capreolus</i> (roe deer)	0	0.0	0	0.0	1	0.1	0	0.0
<i>Cervus elaphus</i> (red deer)	1	0.1	13	1.6	11	1.6	3	0.5
<i>Castor fiber</i> (beaver)	0	0.0	0	0.0	2	0.3	0	0.0
<i>Lepus europaeus</i> (hare)	3	0.3	6	0.7	4	0.6	0	0.0
<i>Meles meles</i> (Eurasian badger)	3	0.3	0	0.0	0	0.0	3	0.5
<i>Mustela nivalis</i> (common weasel)	1	0.1	2	0.2	2	0.3	0	0.0
<i>Ursus Arctos</i> (brown bear)	0	0.0	0	0.0	1	0.1	0	0.0
<i>Mauremys caspica cas.</i> (Caspian turtle)	0	0.0	0	0.0	1	0.1	0	0.0
Aves								
<i>Alectoris chukar</i> (chukar partridge)	0	0.0	2	0.2	0	0.0	0	0.0
<i>Anas platyrhynchos</i> (mallard)	0	0.0	0	0.0	0	0.0	1	0.2
<i>Aquila chrysaetos</i> (golden eagle)	0	0.0	0	0.0	1	0.1	0	0.0
<i>Athene noctua</i> (little owl)	0	0.0	0	0.0	1	0.1	0	0.0
<i>Columba livia</i> (rock pigeon)	0	0.0	0	0.0	1	0.1	0	0.0
<i>Coturnix coturnix</i> (common quail)	1	0.1	0	0.0	0	0.0	0	0.0
<i>Otis tarda</i> (great bustard)	1	0.1	1	0.1	0	0.0	0	0.0
<i>Passer domesticus</i> (house sparrow)	0	0.0	2	0.2	0	0.0	0	0.0
<i>Perdix perdix</i> (grey partridge)	1	0.1	0	0.0	0	0.0	0	0.0
<i>Phasianus colchicus</i> (common pheasant)	0	0.0	0	0.0	0	0.0	1	0.2
<i>Podiceps cristatus</i> (great crested grebe)	1	0.1	0	0.0	0	0.0	0	0.0
Other								
Unidentified fish	1	0.1	0	0.0	0	0.0	0	0.0
Unidentified amphibian	0	0.0	1	0.1	0	0.0	0	0.0
<i>Gastropod</i> (land snail)	1	0.1	0	0.0	1	0.1	0	0.0
<i>Unionidae</i> (bivalves)	39	3.6	28	3.4	12	1.7	3	0.5
Subtotal	53	4.9	55	6.7	38	5.4	11	2.0
TOTAL IDENTIFIED	1085	100.0	826	100.0	708	100.0	562	100.0
Intrusive								
<i>Nannospalax nehrlingi</i> (mountain mole rat)	2		3		1		0	
<i>Mesocricetus brandti</i> (Turkish hamster)	4		2		0		0	
<i>Apodemus sylvaticus</i> (wood mouse)	9		4		0		0	
<i>Crocidura sp.</i> (shrew)	1		0		0		0	
<i>Microtus sp.</i> (vole)	1		1		0		0	
Subtotal	17		10		1		0	
TOTAL	1102		836		2		0	

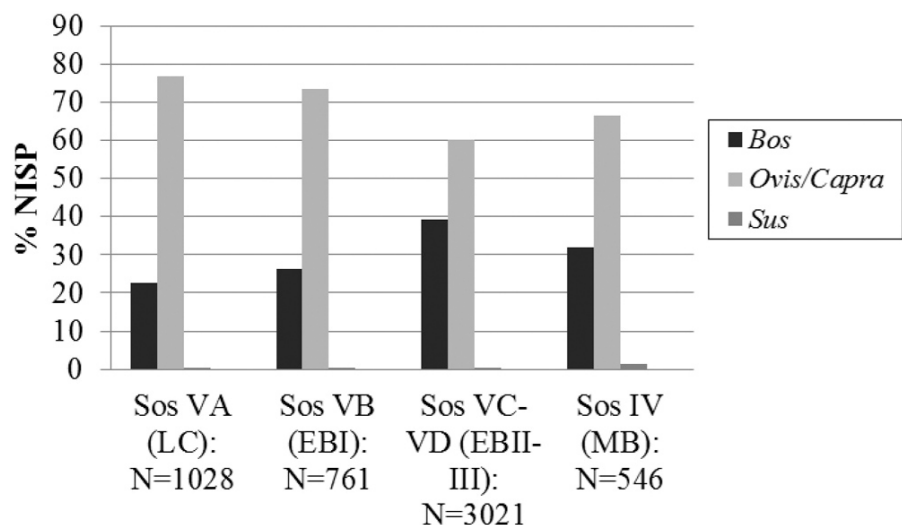


Fig. 19.4. Relative abundance of the main domesticates from Sos Höyük

(% NISP). *EBII–III phase includes data analysed by Howell-Meurs (2001b, 117)*

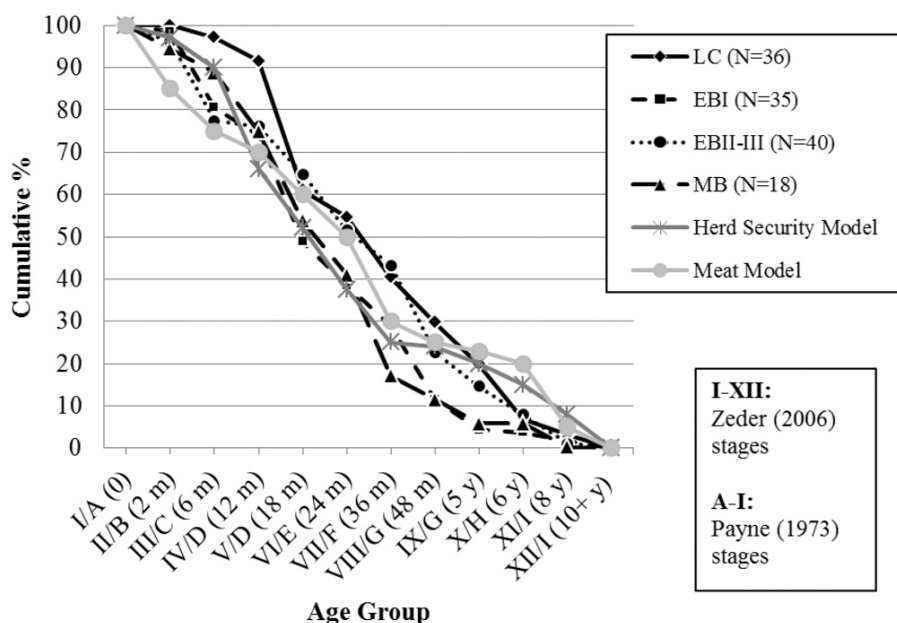


Fig. 19.5. Caprine survivorship based on tooth eruption and wear at Sos. Redding's Herd Security Model (1981) and Payne's Meat Model (1973) are included for comparison

Pastoral production and seasonal mobility at Sos

Strategies centred on risk avoidance likely served as the guiding principle for subsistence practices from the Late Chalcolithic to the Middle Bronze phase at the site. First, the caprine mortality data indicate that production strategies focused on risk reduction, herd security, and the exploitation of a variety of products to meet subsistence needs. Second, the presence of wild taxa in all four phases of the assemblage, even at low levels, may reflect a strategy of resource diversification intended to minimise subsistence risk. While domestic livestock provided the bulk of consumable products in the form of meat and milk, an extensive variety of wild species (particularly the wild cattle, caprines, and pigs noted by Howell-Meurs (2001b, 117)) could be exploited as additional meat sources, when necessary. Third, the herding of domestic cattle, caprines, and pigs may indicate strategies aimed at the diversification of livestock production by exploiting a wide range of environmental niches in the site's vicinity.⁵ A broad-based approach to husbandry practices, together with small-scale hunting, trapping, and agricultural activities,

would help minimise subsistence risk and uncertainty by increasing predictability and stability in the subsistence economy (Halstead & O'Shea 1989, 3–4; Stein 1989).⁶

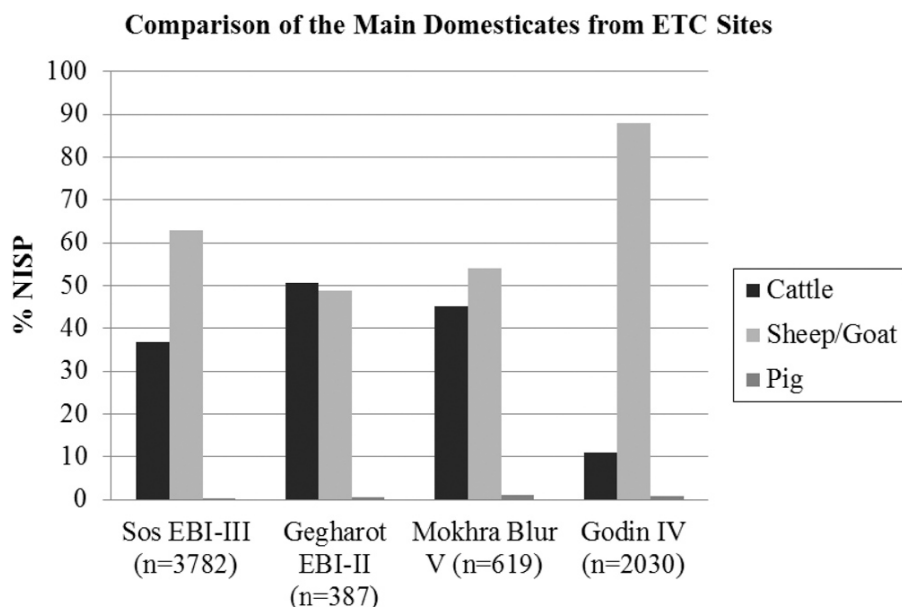


Fig. 19.6. Percentages of the main domesticates from ETC sites (NISP). EBII–III phase includes data analysed by Howell-Meurs (2001b, 117); Gegharot data from Monahan (2005, 386); Mokhra Blur data from Piro (2009, 279–282); Godin data from Crabtree (in press)

In terms of seasonal exploitation of livestock, analysis of tooth eruption data and foetal/neonatal remains suggests that caprines were present at the site throughout the year. The eruption time of the 1st and 2nd molars – at approximately 5–6 months and 9–12 months, respectively – may help estimate the season of death. In the Sos assemblage, the presence of specimens in the younger age groups, particularly the 6 month and 12 month categories, raises the question as to whether this pattern represents year-round mortality or specific seasonal culling. The birthing season of domestic caprines from Sos was likely more comparable to that of wild sheep (*Ovis orientalis*) and wild goats (*Capra aegagrus*), which rut in October/ November and give birth in April/May (MacDonald & Barrett 1993, 219), rather than the extended birthing season associated with the intensive management of sheep and goats by contemporary pastoralists in the Middle East (Redding 1981, 86; Epstein & Herz 1964, 240; Rottensten & Ampy 1971, 371). If lambing occurs in the spring, and mortality occurs among juveniles at 5–6 and 9–12 months of age, this implies the

presence of animals in the autumn, late winter, and early spring at the site.⁷ In addition, the recovery of foetal and neonatal bones shows that pregnant ewes and very young lambs were present at the site during the spring and summer. Together, these data indicate that caprines were exploited at the site throughout the year and, therefore, refute previous interpretations of Sos as a summer encampment associated with transhumant or nomadic forms of pastoralism (Sagona & Sagona 2000, 65). Furthermore, if Sos was occupied only in the summer months, this would be reflected by gaps or peaks in the mortality data. The fact that all age categories are fairly well-represented in the assemblage argues against seasonal herding at the site.

Regional comparison of the main domesticates

Bone remains of the main domesticates from Early Bronze Sos were compared to those from Mokhra Blur and Gegharot, two Early Bronze Age settlements in northwestern Armenia, in order to provide insight into the nature of ETC herding economies on a broader regional scale (Fig. 19.1). These sites are located in very different ecological zones: Mokhra Blur lies in the Ararat Valley, while Gegharot is situated on an upland plain, about 2100m a.s.l.

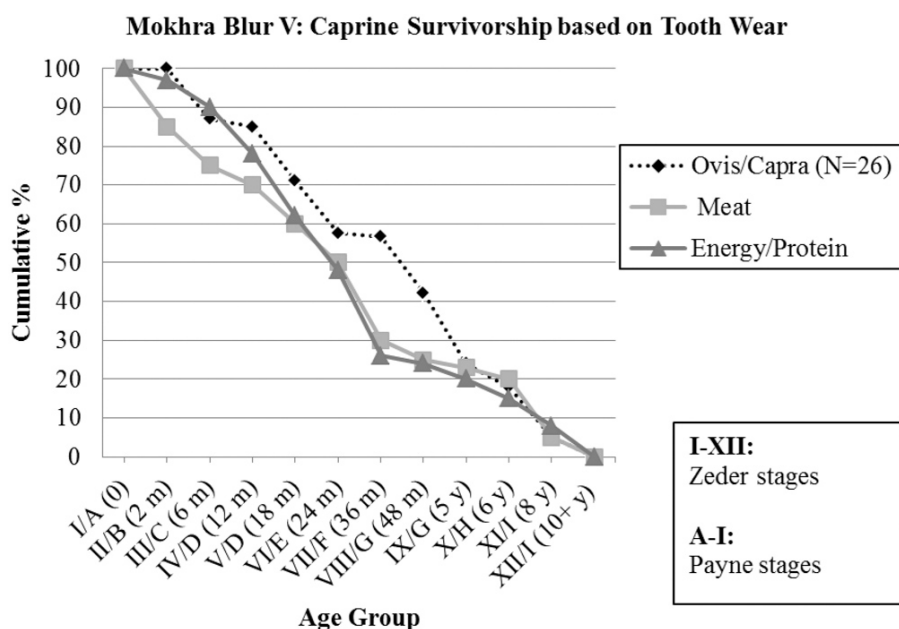


Fig. 19.7. Mokhra Blur V: caprine survivorship based on tooth eruption and wear. Redding's (1981; 1984) energy/protein model and Payne's (1973) meat model are included for comparison

Table 19.2. Number of Identified Specimens (genus) from Mokhra Blur V

Identification	Common Name	No.	Percentage
<i>Bos</i>	Cattle	279	42.0
<i>Ovis/Capra</i>	Sheep/goat	334	50.2
<i>Sus</i>	Pig	6	0.9
<i>Cervus elaphus</i>	Red deer	16	2.4
<i>Ovis orientalis</i>	Wild sheep	19	2.9
<i>Canis familiaris</i>	Dog	11	1.6
Total		665	100.0

Despite the small size of the Gegharot faunal assemblage, the high proportion of cattle suggests that this site was a sedentary village during the early 3rd millennium BC. The assemblage is dominated by roughly equal proportions of cattle (49% NISP, genus) and caprines (47.3%), followed by red deer (2.5%) and very rarely, pigs, equids, gazelle, and weasel (Monahan 2005, 386, table 15.4). Sheep greatly outnumber goats in the assemblage, but this should be taken with caution due to the high fragmentation of bones and the fact that goats were represented by a single specimen. Caprine mortality profiles based on tooth wear are not yet available from Gegharot due to the small sample size.

Similar to Sos, the zooarchaeological evidence from Gegharot questions the commonly held view, supported primarily by ethnographic accounts, that ETC sites in high elevations were linked with patterns of transhumance in the region (cf. Kushnareva 1997, 192). The high proportions of cattle and caprines at both sites, particularly at Gegharot, do not coincide with specialised forms of pastoralism that focus on the production of one species and that may involve the seasonal movement of herds (Fig. 19.6). Moreover, the long duration of Early Bronze Age occupation at Gegharot further challenges the notion of an overall migration of people from the lowlands and valleys to the foothills and mountains during the 3rd millennium BC (Smith 2005, 259; cf. Kushnareva 1997, 188).

The analysis of faunal remains from Mokhra Blur was limited to level V – dated approximately to the first half of the 3rd millennium BC. Interestingly, the relative proportion of species is broadly comparable to that from Gegharot (Fig. 19.6): cattle and caprines dominate the assemblage in roughly equal percentages, pigs are very rare, and red deer are present in small amounts (Table 19.2). Low percentages of wild sheep and dogs complete the assemblage. In terms of productive goals, the pattern of sheep and goat herding at Mokhra

Blur resembles both Redding's (1981; 1984) energy/protein maximization model and Payne's (1973) meat model (Fig. 19.7). However, this interpretation is tentative due to the limited tooth wear data available for analysis.

Godin Tepe IV: Caprine Survivorship based on Tooth Wear

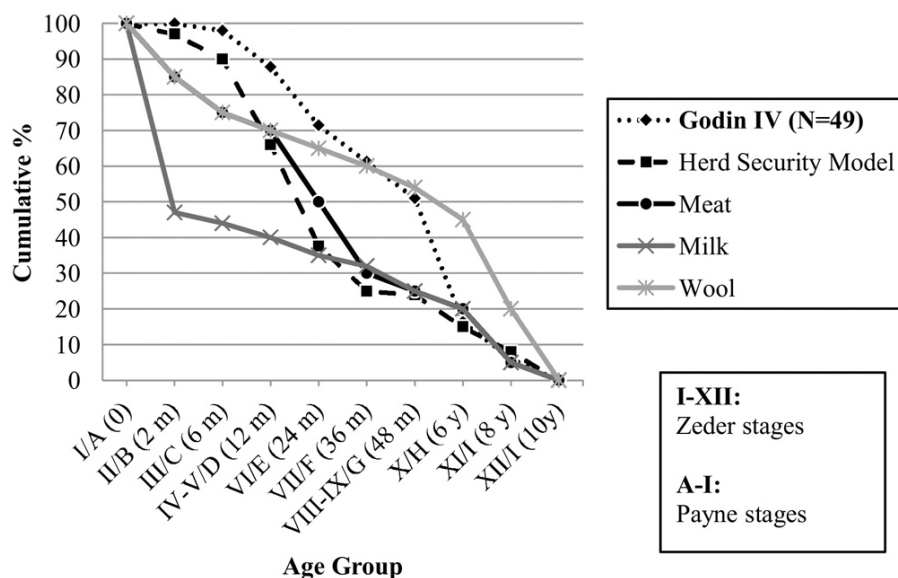


Fig. 19.8. Godin Tepe IV: caprine survivorship based on tooth eruption and wear. Redding's (1981; 1984) herd security model and Payne's (1973) meat, milk, and wool model are included for comparison

Similar to Sos, the pattern of animal use from Mokhra Blur points to resource diversification and conservative production strategies: 1) the broad-based exploitation of domestic livestock, instead of specialised herding; and 2) caprine meat production supplemented by the smallscale hunting of wild caprines and red deer. Moreover, the presence of all age groups at the site indicates that caprines were raised and consumed locally. Overall, the faunal data are consistent with the archaeological evidence (see Areshian & Kafadaryan 1975; Areshian 2005), which together portray Mokhra Blur V as an extremely stable, sedentary agro-pastoral village in the Early Bronze Age.

While the zooarchaeological evidence revealed Sos Höyük, Mokhra Blur, and Gegharot as stable village communities, in which the ETC horizon persisted for over a millennium, animal bone remains from the site of Godin Tepe, located in the Kangavar Valley in westcentral

Iran, may offer insight into the movement of ETC populations into neighboring regions (Fig. 19.2). The faunal remains from Godin IV (ca. 3000–2400 BC) reveal striking differences from those in the ETC levels at Sos, Gegharot, and Mokhra Blur (Fig. 19.6). In terms of species composition, caprines represent over 80% of the identified remains, followed by cattle at a distant second at just over 10% (Table 19.3) (Crabtree 2011). Caprine mortality data from Godin IV indicate an emphasis on secondary product exploitation (i.e. wool, hair, and possibly dairy products) due to the sizeable proportion of older animals in the assemblage (Fig. 19.8). Nevertheless, the kill-off pattern does not correspond closely to Payne’s meat, milk, and wool models for specialised production, nor does it resemble Redding’s herd security model (Kolmogorov-Smirnov two-sample test, $p < 0.01$). The low representation of young animals, particularly below 6 months of age, likely affected the shape of the survivorship curve and may suggest that caprines were raised outside the site’s vicinity.

Table 19.3. Number of Identified Specimens (genus) from Godin IV

<i>Identification</i>	<i>Common Name</i>	<i>No.</i>	<i>Percentage</i>
<i>Bos</i>	Cattle	225	10.6
<i>Ovis/Capra</i>	Sheep/goat	1786	83.8
incl. <i>Ovis</i>	Sheep	333	
<i>Capra</i>	Goat	134	
<i>Sus</i>	Pig	19	0.9
<i>Equus</i> sp.	Horse	76	3.6
<i>Canis familiaris</i>	Dog	4	0.2
<i>Cervus elaphus</i>	Red deer	7	0.3
<i>Capreolus capreolus</i>	Roe deer	9	0.4
<i>Lepus capensis</i>	Brown hare	4	0.2
<i>Meles meles</i>	Badger	1	—
Total		2131	100.0

In terms of cattle management, the paucity of mortality data limits the interpretation of production goals (Crabtree 2011). Available dental and fusion data indicate that most of the cattle (69%) survived beyond 3 years of age, with no evidence for juvenile mortality. This culling pattern, with its focus on adolescents and older adults, points to the importance of cattle secondary products, such as dairying and traction. Pathological conditions (i.e. lipping and exostosis) on cattle phalanges and the occurrence of plow marks provide further evidence of traction activities.

The zooarchaeological evidence from Godin provides insight into

the degree of mobility and the type of pastoralism practiced at the site. It appears that the inhabitants of Godin IV raised caprines for meat and secondary products, particularly wool, within a broad subsistence base that included agriculture and hunting. In this respect, Godin IV may be considered a sedentary village, with a number of the inhabitants living at the site year-round. Clear evidence of pathologies associated with penning indicates that caprines were kept at the site (Crabtree 2011). Yet, the overwhelming proportion of caprines in the Godin IV sample, along with the absence of the younger age categories in the mortality profiles, may indicate that some animals were kept away from the settlement (Crabtree 2011). It is possible that some members of the site may have moved the caprine herds on a seasonal basis, perhaps by practicing vertical transhumance – a form of pastoralism still visible today in the Zagros region. Alternatively, local pastoral groups in the area may have provisioned the settlement. Although secondary products were important, the low sheep to goat ratio (2.5:1) and the caprine mortality pattern argue against highly specialized forms of pastoral production.

In terms of ETC migrations, the zooarchaeological data from Godin appear to corroborate Mitchell Rothman's model describing the gradual infiltration of new populations from Transcaucasia into west-central Iran (Batiuk & Rothman 2007; Rothman 2003; 2005). According to this model, the increase in the number of cave sites, open air sites, and isolated cemeteries in highland areas during the Late Chalcolithic – and the occurrence of small amounts of ETC ceramics at some of these sites – suggests the arrival of ETC pastoral nomads. Following this period, many new sites with exclusively ETC ceramics were established on the valley bottom, while a few abandoned Late Chalcolithic sites, such as Godin, were reoccupied. Thus, Godin IV would represent the reoccupation of the site by incoming ETC settlers. On the whole, faunal evidence demonstrating sedentary or transhumant agro-pastoralism at Godin is consistent with this view. However, it is also possible that pastoralists, who were part of the first wave of ETC migration, or even local Late Chalcolithic pastoralist groups who may have existed on the margins of the site, may have interacted with the Godin IV settlement (Young 2004, 257). More analysis of faunal assemblages from postulated ETC migration sites is necessary to continue testing this model and to clarify the role of pastoral movements in the spread of the Early Transcaucasian Culture.

Conclusion

The comparison of faunal data from sites with ETC occupation phases indicates that herding strategies may not coincide with expectations based on settlement type and location. The nature and extent of pastoral activities at ETC sites appears to be influenced not simply by ecological conditions, but by a range of social, economic, political, and cultural factors with varying degrees of archaeological visibility. Thus, it is challenging to define what constitutes a ‘typical’ ETC pastoral economy, especially given the general paucity of carefully analysed faunal data from ETC sites. What is clear, however, is that the emphasis on highly mobile forms of pastoralism both as a defining feature and as a mechanism for the creation and spread of the Early Transcaucasian Culture must be reconsidered. As larger faunal samples from additional ETC sites become available, we can examine this heterogeneity in herding economies more closely and assess whether they are indeed part of a broader trend of agro-pastoralism across the region or whether mobile forms of pastoralism were the dominant strategy at certain sites. Such analyses are the necessary foundation for understanding the processes behind the spread of the ETC phenomenon across the Near East.

Acknowledgements

Analysis of the fauna from Sos Höyük was funded by grants from the Sigma Xi Scientific Research Society and the Center for Ancient Studies at New York University. Analysis of the fauna from Mokhra Blur V was funded by a Fulbright IIE grant to Armenia (2004–5). Additional thanks go to Dr Tony Sagona (co-director of the Sos excavations) for the opportunity to analyze the animal bone remains from Sos; Dr Hakob Simonyan, (Center for Armenian Culture and Historical Heritage, Armenia) for permission to study the faunal remains from Mokhra Blur; Dr Nina Manaseryan (Institute of Zoology, National Academy of Sciences, Armenia) for assistance and guidance with the animal bones from Mokhra Blur; and Dr Mitchell Rothman, who arranged for the Godin fauna to be analysed at the NYU Faunal Laboratory. Final responsibility for content rests with the authors.

Notes

- 1 The zooarchaeological evidence from Sos and Mokhra Blur (Level V) was analysed by Piro (2009) (see also Howell-Meurs 2001a; 2001b). Faunal remains from Gegharot were studied by Monahan (2005), while those from Godin were examined by Crabtree 2011.
- 2 Previous analysis of faunal remains conducted by Howell-Meurs (2001a; 2001b) from the later Early Bronze Age at Sos is included in this study.
- 3 See Howell-Meurs (2001b, 117) for additional identified species from the EBII–III phase.
- 4 See Piro (2009, 345–360) for tables and figures detailing caprine mandibular data by phase and Howell-Meurs (2001b, 171) for additional caprine dental data from the EBII–III

phase.

5 See Longford *et al.* (2009) and Newton's section in Sagona & Sagona (2004, 109–110) for in-depth discussions of the ancient landscape at Sos.

6 Several varieties of domesticated wheat and barley – both hulled and naked types – were found in the Late Chalcolithic and Middle Bronze levels at Sos (Longford *et al.* 2009, table 2).

7 This pattern was also documented by Howell-Meurs (2001b, 99) in her analysis of caprine tooth eruption from the EBII– III phase at the site.

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Part 5

Exploitation of animals in the Arabian Peninsula

20. New data on domestic and wild camels (*Camelus dromedarius* and *Camelus* sp.) in Sabaean and Minaean Yemen

F. G. Fedele

*Recently studied faunas from controlled, dated Sabaean archaeological contexts provide information on the presence of both domestic and contemporary wild camel in the 9th–7th century BC time range in Yemen. Although still very limited this evidence may be of interest. The wild or domestic status was determined on the basis of both osteometrical data and archaeological context. Domestic *Camelus dromedarius* was occasionally butchered for household meat consumption at Yalā (Ad-Durayb), southwest of Marib, in two subsequent occupations that can be dated within the 8th–7th century BC, if not slightly earlier (A. de Maigret's excavations). At Barāqish, in the Wadi al-Jawf region of northeastern Yemen, deep stratigraphic testing outside the walls in 2005–2006 has revealed a long sequence of occupations spanning the whole 1st millennium BC (F. G. Fedele's excavations). The domestic camel is frequent throughout the series, increasing in numbers during the post-Sabaean phases. Its earliest presence can again be dated to the 8th century BC, in association with probable evidence of early trading activities. A unique find of this period, an isolated humerus deriving from a caravan 'campsite' context on the outskirts of the Sabaean town, suggests the existence of wild *Camelus* populations in the area.*

Keywords Domestic dromedary, wild dromedary, Sabaean, Yemen, Yalā

Introduction and background

In a wide-ranging reappraisal of *Camelus* domestication in the Arabian Peninsula, and discussion of camel domestication in general, Uerpmann and Uerpmann (2002) have argued for the relatively late appearance of the domesticated dromedary in southeast Arabia. On present zooarchaeological evidence they suggest that all the remains of domestic camels date from the Iron Age II onwards, and particularly from after 900 BC. This is at least a century later than the assumed earliest appearance of domestic camels in the Levant, or arguably in the general area of the northern Arabian fringe. In these latter regions, reliable historical sources in Assyrian records (e.g. Liverani 1992; Na'aman 2007) point to the presence of domestic dromedaries in the 9th century BC, or somewhat earlier by implication, while osteological evidence from the southern Levant (e.g. Horwitz & Rosen 2005; Wapnish 1984) documents a pronounced increase in their utilisation from about 800 BC. The sociocultural context appears to be provided by a combination of rapidly evolving caravan trade and a new political assertiveness by 'aggressive' pastoral nomads of the Arabian area. Plausible evidence for a much earlier domestication in the 13th–12th centuries BC will be discussed below.

The late appearance of osteologically domestic camels in the Gulf, as particularly recorded at the large stratified settlement of Tell Abraq and at Muweilah in the U.A.E. (Magee 2007; Potts 1991; 1993) (Fig. 20.1), can be taken as evidence against an independent domestication of the dromedary in southeast Arabia. This very much reopens a debate, as noted by Magee (2007, 94), the details of which are beyond the limits of this paper. In addition, this might lead to the rather surprising conclusion that southern Arabia should be excluded from any role in camel domestication. But in fact most of the Peninsula has yet to be investigated. Uerpmann and Uerpmann (2002, 258) are careful to conclude that 'clear biological evidence of when and where the Arabian camel was first domesticated is still missing', and go on to suggest that 'future research should concentrate on northern Arabia, although southern Arabia is not ruled out as a potential area of origin'. To the extent that direct bone evidence is considered of primary importance to recognise domestication, such statements represent the most that can be said at the moment concerning the Arabian camel.

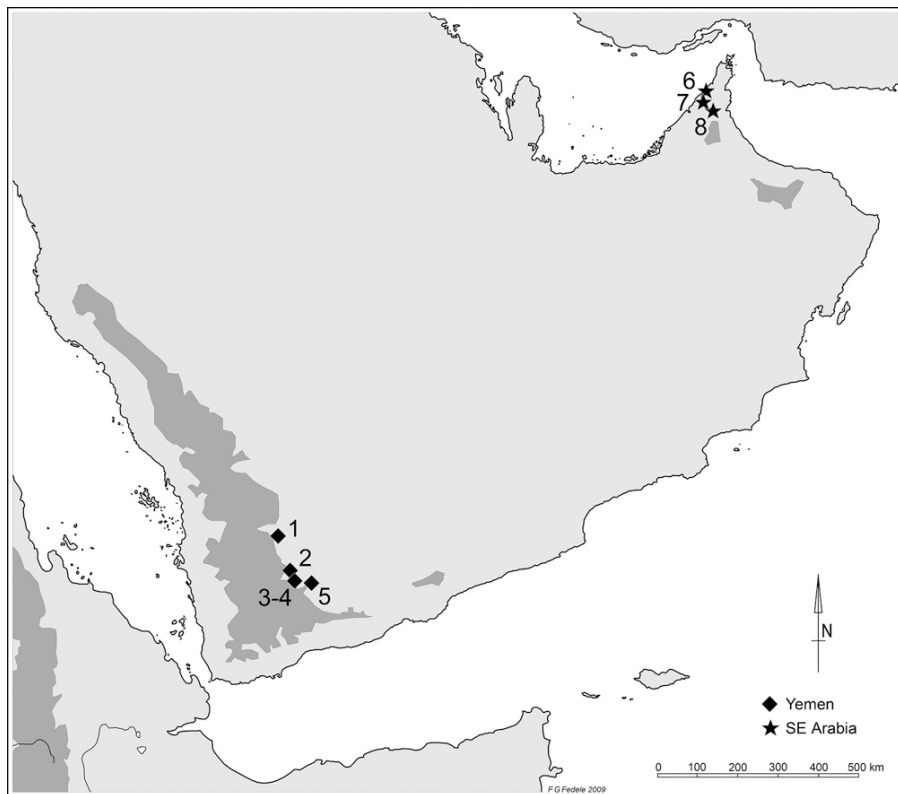


Fig. 20.1. Locations of the sites mentioned in the text (Yemen and Southeast Arabia): 1. Barāqish, 2. Yalā, 3. Hajar ar-Rayhānī, 4. Hajar at-Tamra, 5. Hajar Ibn Humayd, 6. Tell Abraq, 7. Muweilah, 8. Mleiha.

As a subject of broad archaeological and anthropological interest, the origins and early developments of domesticated camels in the Old World have generated a considerable amount of literature and debate. The discussion has often suffered from ineffective dialogue between textual and osteological analysts, and even from misunderstandings on the part of some culture historians of the fundamental differences between the two species concerned, the Bactrian camel in cold-winter central Asia and the dromedary in hot, dry Arabia (Payne & Wilson 1999). In principle, ecologically distinct species would call for distinct domestication histories. This is true even if they are considered to be subspecies (Köhler 1981; Wapnish 1983, 104 n. 6; Wilson 1997). Equally underestimated by less zoologically-focused scholars has been the fact that until very recently the *wild* dromedary was unknown, thus negating the possibility of documenting a direct relationship between a wild ancestor and the domestic descendant in Arabia or elsewhere. The distinction of *Camelus dromedarius* and *Camelus* sp. in the title of this paper reflects this problem (cf Uerpmann & Uerpmann

2008, 102–103).

In the field of osteology, quantitative studies of body size and proportions conducted from a zooarchaeological perspective only began a decade ago (Uerpmann 1999; Uerpmann & Uerpmann 2002), in spite of size indexes having been applied to species other than camels for a considerable time. Renewed criticisms of the value of size index scaling techniques to detect early animal domestication (e.g. Lesur 2007, 56; Vigne, Helmer & Peters 2005, 6–7, with references) do not detract from the fact that such morphometric statistics can greatly help in comparing size when dealing with small ungulate assemblages. One such device, the logarithmic size index (LSI), will be consistently employed below. LSIs provide an objective method for scaling measurements of different skeletal elements in order to make them comparable (see Uerpmann & Uerpmann 2002, 252). Recent examples, notably Beech *et al.* (2009) working on *Camelus* sp. remains in Abu Dhabi, suggest that the LSI continues to have good comparative value.

centuries BC	Barāqish A/S1	C/S1	Yalā (1987)	Hajar at-Tamra	H. ar-Rayḥānī Strata	O.P.	Hajar Ibn Ḥumayd	
3rd					Vc-a	6th 5th	D	—
4th	(Minaean C-A)	I			Vh-e	4th	E	—
							F	—
5th		?					G	—
		J			VI	3rd	H	—
6th	?	?					J	—
		K					K	—
		L					?	—
7th		M					L	—
		N			Vh-e	wall	M	—
	A	Q-P-O R, wall	destruction				N	—
8th	B	S	House A	abandonment			O	—
	C	T			VI		P	—
9th	D	base of excavation			VIIa	2nd	Q	—
					VIIb		R	—
10th	E							—
	F				VIIc	1st	S	—
11th	G				base of sounding			—
	H							—
	I							—
12th	J							—
	K							—
13th	L							—
	M							—
	base of sounding		virgin soil	virgin soil			virgin soil	—

Fig. 20.2. Comparative stratigraphy and radiocarbon chronology of the five Yemeni Iron Age sites discussed in this paper. See text for relevant details. Abbreviations in the Hajar ar-Rayḥānī column: O.P. = Occupational phases, deM = A. de Maigret's (2010) correlation.

The still fragmentary knowledge of early dromedary control in the Arabian Peninsula confers potential interest on new archaeofaunal evidence from Yemen. This paper reports information on the early presence of both the domestic and wild camel in southwest Arabia in association with the Sabaean culture of the 9th–7th centuries BC, if not slightly earlier. These data primarily derive from the walled cities of Yalā and Barāqish, both excavated by the Italian Archaeological Mission (Fig. 20.1). Faunal collections from both sites have recently been studied, and work at Barāqish is expected to continue. Although small, the assemblages come from stratified, controlled archaeological contexts precisely defined by diagnostic pottery and a preliminary radiocarbon chronology. At Barāqish the *Camelus* record expands during the subsequent Minaean period until the end of the city, round the beginning of the current era. On morphological grounds (Köhler-Rollefson 1989; Steiger 1990; Wapnish 1984), all camel remains discussed in this paper come from the dromedary or its wild form. Their cultural status – whether domestic or wild – was determined on the basis of osteometric and LSI values independent of archaeological context, however important this latter for socio-cultural interpretation.

The study of Yalā and Barāqish provides a basis for appraising additional material from Yemen. In particular, an attempt is made to reassess the camel samples that were obtained from three other settlements of the ‘early’ South Arabian culture, or the Sayhad Iron Age (as called by Edens & Wilkinson 1998, 95). Listed according to their date of excavation, these samples derive from Hajar Ibn Humayd, Hajar at-Tamra and Hajar ar-Rayhānī (Fig. 20.1). The sites were investigated by the American Foundation for the Study of Man (henceforth AFSM) with a 30-year interval between the sounding at Hajar Ibn Humayd in 1950–1 and the subsequent two (Glanzman 1994, 8–27). Due to their geographic and environmental proximity the AFSM sites will be considered in detail after examination of Yalā. The camel remains from the northern, desert-edge city of Barāqish will be presented in a further section.

Fundamental of course to the historical evaluation of the bone assemblages are the stratigraphy and associated dating of the archaeological sequences from which they derive. This point only needs to be emphasised because both the pottery sequences and their intersite correlation, on one side, and their radiometric chronology on the other, still represent work in progress as far as the Sayhad Iron Age is concerned (e.g. de Maigret 2003; 2010; Fedele 2010; Glanzman

1994). For the purposes of the present paper the chronology of the relevant sites has been compiled in [Figure 20.2](#). The figure provides an interim correlationchronological chart based on comparative stratigraphy and calibrated radiocarbon determinations, and must be understood as a critical synthesis of partially controversial information. Several underlying assumptions will be discussed on a site by site basis beginning with Yalā.

Yalā (or Hajar ad-Durayb)

The ruins locally known as Hajar ad-Durayb near the present-day village of Yalā, or Yalā' (Tiede & Overstreet 1988, xxxviii), were reported by Alessandro de Maigret in 1985. A 2.3 ha walled settlement measuring 230 × 170m across, the city was identified epigraphically with ancient Hafarī (cf Robin & Brunner 1997). A topographic survey of the Yalā area led to recognise that the city was only part of a larger and remarkable archaeological complex of the early Sabaeen period. This included a dam, an agricultural estate composed of farms, and a rocky gorge where engraved inscriptions recorded the performance of ceremonial ibex hunts (de Maigret 1988; 2002, 173–186, 273–285, with references). The locality lies in Wādī Yalā, 30 km southwest of Mārib, at an altitude of 1280m above sea level, on the eastern border of the upland region of Khawlān at-Tiyāl.

Because of local difficulties, an excavation at Yalā only became possible in 1987. A well-preserved, twostorey house in the upper part of the tell was excavated in its entirety (House A; de Maigret & Robin 1989). This building had been destroyed by fire and its occupancy represents Stratum A of the city's sequence as currently known. Its destruction broadly corresponds with the end of Yalā. Testing beneath the floor revealed earlier layers and structures which were grouped as Strata B, C and D, with D probably resting on virgin deposits ([Fig. 20.3](#)). Animal remains were present in all layers from A to C, totalling about 3000 specimens (Fedele 2009). The occupation sediments within the house were particularly rich, and included the stratigraphically sealed ground floor and a collapsed upper floor. A spatial-functional study of the house has jointly been made from the pottery assemblage (de Maigret 2003; Loreto 2009) and the faunal collection (Fedele 2009), on the premise that they plausibly represent the domestic refuse from a single household during a defined period of time.

The presence of domesticated camels in the fauna, whose significance appeared to be crucially contingent on their temporal placement, has prompted a critical reappraisal of Yalā's stratigraphy

and chronology (de Maigret & Robin 1989). Recalibration of the five radiocarbon measurements (Edens & Wilkinson 1998, 94; Fedele 2009, 138, fig. 3, and unpublished documents; Manzo 2005), pottery parallels (de Maigret 2010) and epigraphic evidence suggesting a continuance of Yalā into the reign of *mukarrib* Karib'il Watār I, ca. 700–680 BC (e.g. Robin 2002), support the following dates for the sequence (see [Fig. 20.2](#)):

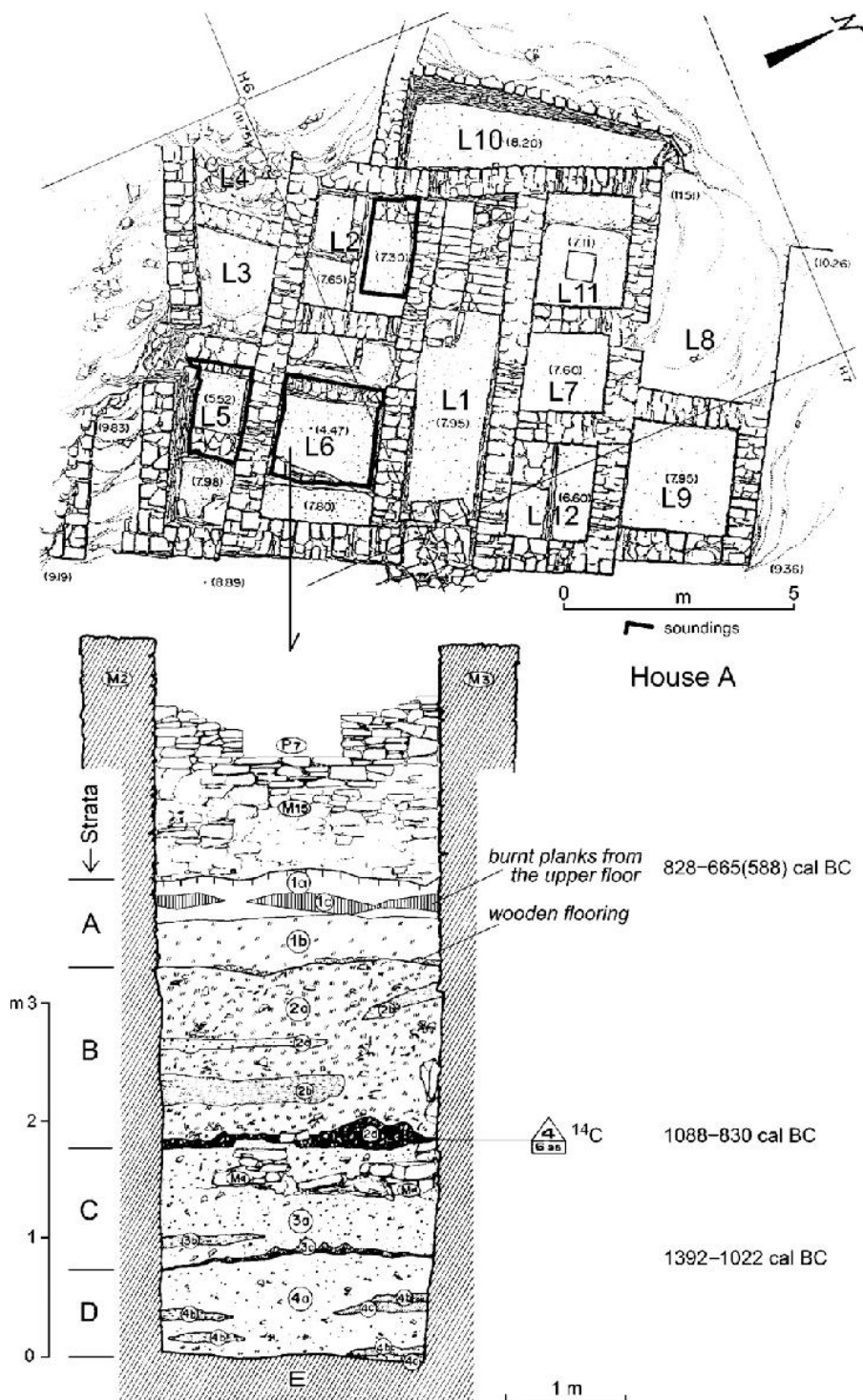


Fig. 20.3. Yalā, House A: a complete stratigraphic profile obtained from room L6, with plan above. Adapted from de Maigret (2002, pl. 6) (plan)

and de Maigret & Robin (1989, fig. 3) (profile), with added information, after Fedele (2009, fig. 2).

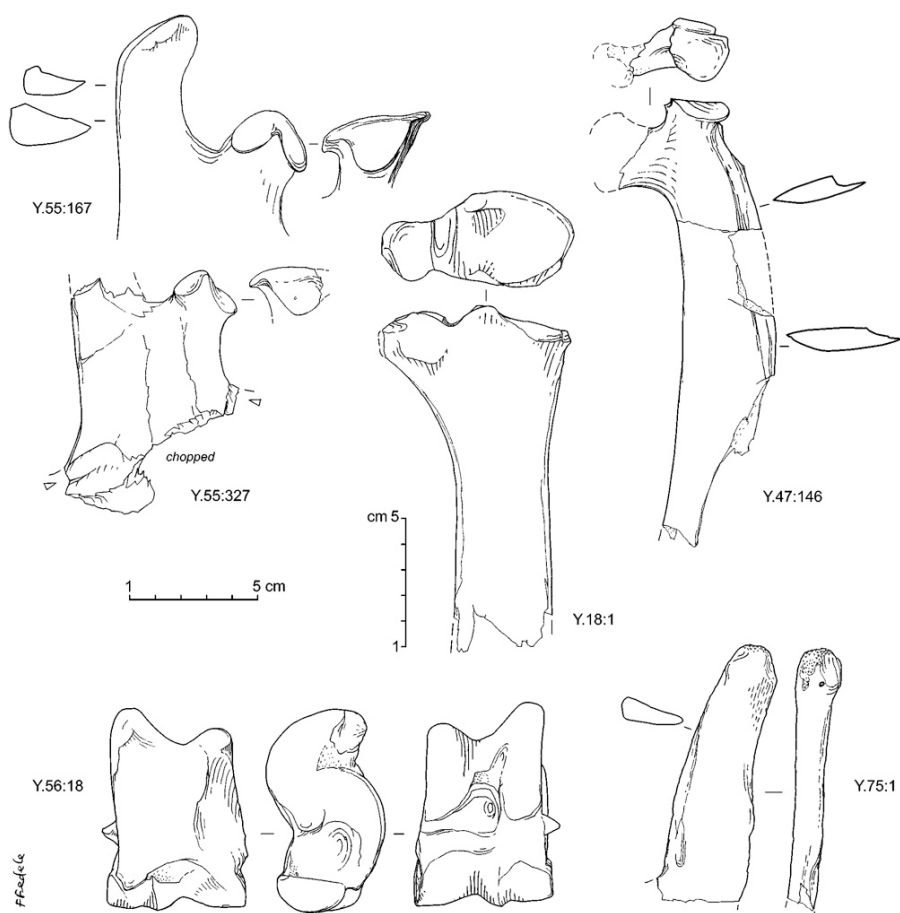


Fig. 20.4. Yalā. *Camelus dromedarius*, a selection of bone finds.

- End of the house and city ca. 650 BC;
- Stratum A ca. (850)800–650 BC (occupation of the house $\leq$ two centuries);
- Stratum B ca. 1050–(850)800 BC;
- Stratum C ca. (1300?)1200–900 BC.

Sixteen *Camelus* bone finds were identified from the house floor and the underlying upper part of Stratum B, level 2a; there are in addition four less certain fragments (Fig. 20.4, Table 20.2). An astragalus, Y.56:18, represents *C. dromedarius* on the basis of its distinctive morphology and proportions (Steiger 1990, figs 50–53; Uerpmann

1999, figs 6–7; Wapnish 1984, figs 5–6). On visual impression it seems likely that all the identifiable bones are from dromedaries. Only four bones from the house provide usable measurements, of which three allow logarithmic size indices to be calculated (Tables 20.1 & 20.2) and checked against Arabian biometric records (Fig. 20.5). The comparisons show that the dromedary bones from Yalā have a relatively small size and clearly fall within the domestic range (radius = -0.072 ; astragalus = 0.008 ; first anterior phalanx = -0.032). Furthermore, taken together, they provide an osteometric mean of -0.032 (or -0.012 if the slightly immature radius is excluded): a mean closely similar to the values for the Iron Age II ‘reference’ sites of Tell Abraq and Muweilah in southeast Arabia (Uerpmann & Uerpmann 2002). The LSI total ranges are also similar.

Table 20.1. List of abbreviations for non-standard bone measurements (not defined in von den Driesch 1976) used in Tables 20.2, 20.4 and 20.6. BLF according to Uerpmann (1999, fig. 6, ‘BAQ’)

<i>Skeletal element</i>	<i>Abbreviation</i>	<i>Definition</i>
Mandible	Wram	minimum width of
		mandibular vertical
		ramus (at constriction)
Mandible	Bcon	mediolateral breadth of
		articular condyle
Mandible	H _{P/M}	height of mandibular
		body at the P/M contact,
		lingual side (cf no. 15b
		von den Driesch for <i>Bos</i>)
Mandibular cheekteeth	La, Lo	alveolar, occlusal length
Mandibular cheekteeth	Ba, Bo	alveolar, occlusal
		breadth
Humerus, distal	HT	maximum height of
		trochlea, medial side
		(Payne)
Humerus, distal	HTC	height of trochlea at
		main constriction
		(Davis)
Humerus, distal	Dd	greatest depth of the
		distal end, by analogy to
		Dd of tibia
Astragalus	BLF	breadth of the lateral
		articular surface of distal
		trochlea
Rib	GLV	greatest length of the
		dorsal (vertebral) end,
		head to tubercle

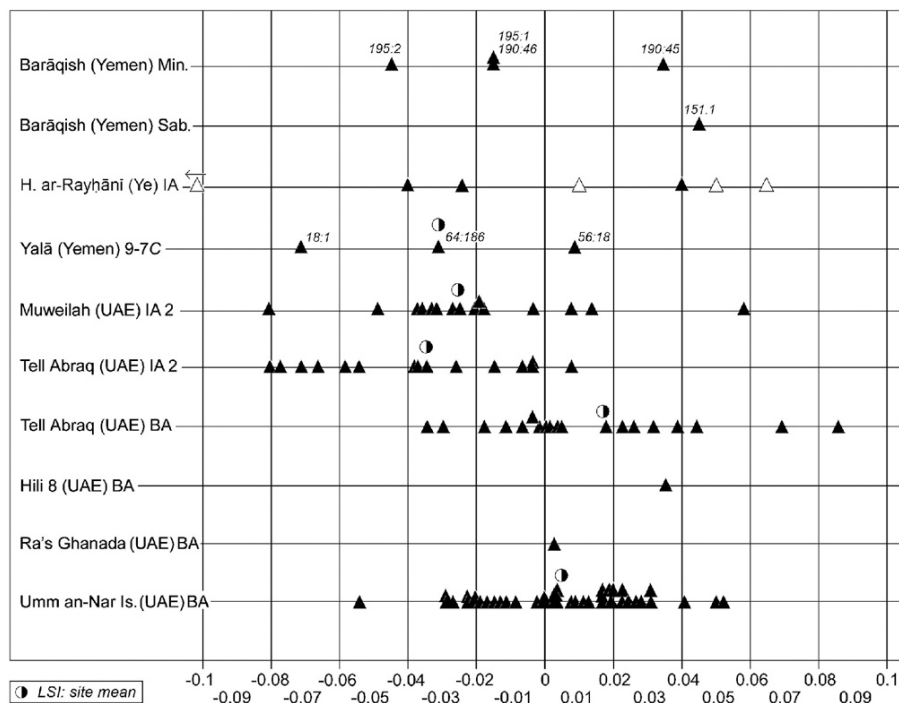


Fig. 20.5. *Camelus*: distribution of logarithmic size indices (LSI) of bone finds from Yalā, Barāqish, and Hajar ar-Rayhānī compared to background information for Southeast Arabia (after Uerpmann & Uerpmann 2002, as redrawn in Beech et al. 2009, fig. 9). The white triangles indicate approximate values.

The earlier fragments from upper Stratum B, level 2a, include two mandibular rami from which non-standard measurements can be taken (Fig. 20.4; Tables 20.1 & 20.2). Such measurements have little comparative value, but in conjunction with bone morphology and appearance they suggest that we are dealing with domestic animals well within the variation observed later in the house. A domestic status is equally suggested by context. This is of particular interest in the light of Yalā's chronology. The upper levels of Stratum B show masonry features of an earlier phase of the house and can probably be dated before 800 BC. These bones thus establish the presence of dromedaries in a domestic context at Yalā during the second half of the 9th century BC, or at a cautious minimum date of about 800 BC. Nondiagnostic 'large-size' fragments from lower levels of thick Stratum B (Fedele 2009, fig. 6) may in part be derived from camels. A clay figurine of a camel is among the surface finds of the 1985 survey at Yalā (de Maigret 1988, fig. 27).

Table 20.2. Yalā, House A and earlier layers: list of identified *Camelus*

bone finds. Measurements in mm, with estimates in parentheses, as defined in von den Driesch (1976) and in Table 20.1 (accessory measurements). LSI is the averaged logarithmic size index

Yalā: *Camelus dromedarius*

			House A								
Find no.	Locus	Skeletal element	Measurements								LSI
			GL	SD	CD	Bp	BFp	Dp			
Y.18:1	GF:L2	Radius _s px (J)	—	(37)	—	72.6	66.5	(37)	−0.072		
Y.56:18	GF: L10	Astragalus, A*	GLI	GLm	DI	BLF	Bd	GB			
			77.2	69.1	45.7	20	52.2	54.9	+0.008		
Y.64:186	GF: L11	Phalanx 1 ₃ an, px half A	GL	GLpe	SD	Bp	Dp				
			—	—	(20)	36.1	—		−0.032		
Y.47:146	GF: L10	Mid-thoracic rib fr A	GLV	>55							
Non-measurable finds											
Y.18:2	GF: L2	Long-bone diaphysis fr A									
Y.49-V:1	GF: L6 ck	Thoracic vertebra J			whole, shattered						
Y.75:1	GF: L12	Thoracic vertebra spin.			103mm long						
Y.75:33	GF: L12	Thoracic vertebra spin. fr A									
Y.35:100	UF (L6)	Thoracic vertebra spin. A			155mm long						
Y.75:40	GF: L12	Rib median fr A									
Y.75:39	GF: L12	Pubis, acetabular fr J			from ashes, just fused						
Y.56:19	GF: L10	Astragalus px fr A									
? Camelus											
Y.67:144	GF: L9	Flat-bone fr A									
Below house: Stratum B, level 2a											
			Wram	Bcon							
Y.55:167	(L6)	Mandible, ramus fr A	62	39.6		chopped					
Y.55:327	(L6)	Mandible, ramus fr A	55.2	—		chopped					
Y.55:168	(L6)	Mandible, fr + rM A			charred, gray						
Y.28:12	(L5)	Radius _s sliver A			chopped						
? Camelus											
Y.31:1	(L5)	? Mandible fr A			weathered						
Y.55:370	(L6)	Epiphyseal fr J			camel size						
Y.55	(L6)	Heavy & dense frs of long-bone diaphyses and flat bones A			4–5 frs are probably camel						

* In addition to the formal measurements here reported, an estimate of the medial depth Dm (‘impossible to measure precisely’; von den Driesch 1976, 89) gave a value of 36.5 mm.

Locus: GF = ground floor; UF = collapsed upper floor; ck = cooking structure (oven?). Osteology codes in alphabetic order: A = full adult; an = anterior; d/s = right/left; fr/frs = fragment/s; J = juvenile; px = proximal; rM = root of molar tooth; spin. = spinous process; 3 = third or axial toe (phalanges)

The dromedary appears at Yalā in a faunal context characterised by a limited range of species, with overwhelming domestic stock throughout the sequence (97.1% of identified specimens). Overall, sheep and goats are by far the most common livestock (82%), followed by taurine cattle (11.5%) and in much smaller numbers by the dromedary (1.6%) and the occasional donkey (1%). The dog and a few wild game animals – gazelle, ibex, hare – are documented in trace amounts. To some extent this faunal composition reflects food consumption. No doubt, domestic dromedaries were occasionally butchered for their meat, not unlike the standard meat animals. This is

indicated by chopping traces on most of their bones (very obvious in eight cases) as well as modifications from burning (one bone from the house and two from Stratum B). A limited food bias may perhaps be perceived in the representation of skeletal parts (Fig. 20.6), where vertebrae and ribs – almost certainly under-diagnosed – tend to outnumber the other bones. Also indicated in the figure with the letter ‘J’ are the elements from immature animals, three bones from the house and a ‘?Camelus’ fragment from Stratum B. If dromedaries were mostly butchered as full adults, this might imply that they were primarily used for milk, fibre and transport – as working and producing animals. The variation in the adult mandibles from Stratum B would suggest that both sexes are represented. Obviously, biological statistics have limited value on such a small sample, and clues to the herd composition cannot reliably be derived.

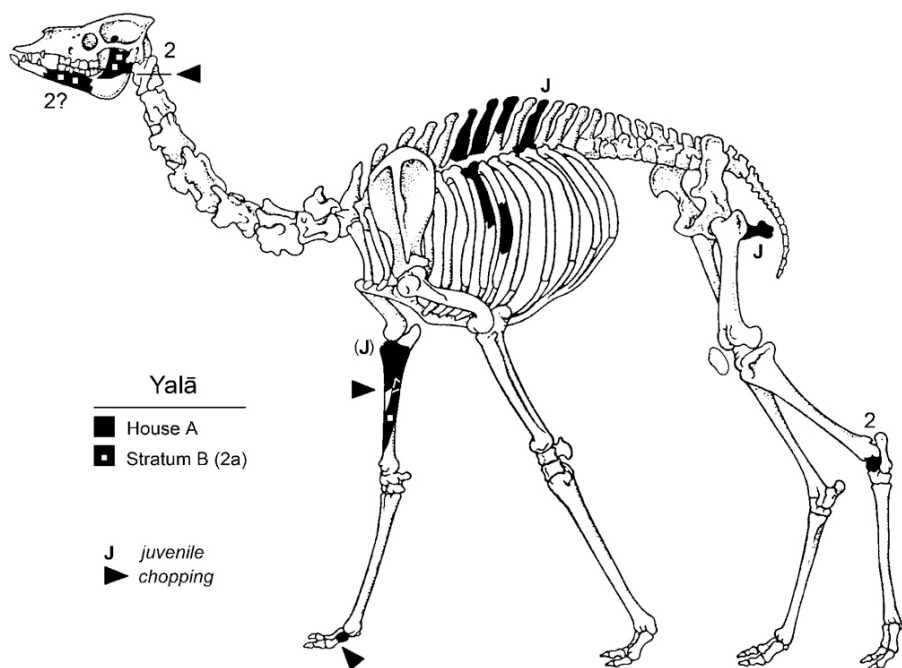


Fig. 20.6. Yalā. *Camelus dromedarius*, representation of skeletal parts.
Camel skeleton redrawn from Kingdon (1988).

The above data cast some light on two complementary, poorly known facets of an Early Sabaean settlement: its animal economy and the use of animals in household consumption. At Yalā the faunal record is probably too biased in a functional sense – meat processing for domestic use – to fully portray the significance of the dromedary at the regional level. However, the results from Yalā do not seem to be

only local (Fedele 1992, 74–75; 2009; see also Edens & Wilkinson 1998, 99–100). The faunal picture closely resembles that obtained from the Wādī al-Jūbah lowlands to the southeast, see next section, while indirect evidence for the role of camels, suggested by the settlement organisation, is available from the city of Mārib (Japp 2008). The message is clear: between about 850 and 650 BC dromedaries had become common animals in the domestic stock of this part of Yemen, even at a distance from the famed Frankincense Road. Yalā is interesting in this context precisely because it lies away from the routes employed by long-distance caravan trade. By the late 9th century BC the dromedary, although on occasion appreciated at the table, had in fact acquired the complete multiplicity of roles that was to be its lasting distinction (e.g. Gauthier-Pilters & Dagg 1981; Köhler-Rollefson 1991; 1996; Wilson 1984).

Wādī al-Jūbah and Wādī Bayhān sites

a. Hajar ar-Rayhānī (HR3) and Hajar at-Tamra (HT12)

Hajar ar-Rayhānī, ancient Marda', is the largest Iron Age settlement in Wādī al-Jūbah, 40km south of Mārib (Fig. 20.1). A relatively low tell, it is located on a branch of the main trade route that linked the ancient Sabaean capital with Wādī Bayhān, hence with the major site of Hajar Ibn Humayd which will be considered below. Hajar at-Tamra (this spelling after Robin & Brunner 1997) is a smaller mound located 7km south-southeast of ar-Rayhānī. Both sites were tested by the renewed AFSM mission, at-Tamra in 1983 (Blakely 1985) and ar-Rayhānī in 1984 and 1987 (see Glanzman & Ghaleb 1987 and Glanzman 1994, respectively). A detailed stratigraphic sounding was conducted at this latter site, and virgin soil was reached at a depth of approximately 9m, reportedly corresponding to the mid- or late 2nd millennium BC and to some earlier 'pre-site' deposits (Glanzman 1994; Blakely 1996). The 1987 campaign is *de facto* unpublished, however, apart from Glanzman's (1994, 51–97) important updating on stratigraphic ordering and chronology, complemented by some subsequent refinements (Glanzman 1987b; 2004a; 2005). Nothing is known of the faunal finds that were obtained.

Table 20.3. Stratigraphic distribution of camel finds at Hajar ar-Rayhānī (after Hesse 1996a, table 1; 1996b, table 8.05) and Hajar at-Tamra (Toplyn 1985, corrected). NISP = number of specimens identified to species or genus, mammals only, per layer

<i>Hajar ar-Rayhānī</i>	<i>Camel bones</i>	<i>Total NISP</i>	<i>Hajar at-Tamra</i>	<i>Camel bones</i>	<i>Total NISP</i>
mixed Va–IIa	16	760	Surface	–	9
Stratum II	–	101	Stratum I	6	91
Total III	11	724	Total II	6	168
Stratum IIIa	2	333	Stratum II indet.	2	30
Stratum IIIb	5	221	Stratum IIa	–	88
Stratum IIIc	4	170	Stratum IIb	3	21
Total IV	7	354	Stratum IIc	1	29
Stratum IVa	–	91	Stratum III	*	35
Stratum IVb	4	135	Stratum IV	*	57
Stratum IVc	3	128	Stratum V	–	84
Total V	30	2097	Pre-Stratum V	–	1
Stratum Va	12	376	Total	12	445
Stratum Vc	13	708			
Stratum Vd	–	82			
Stratum Ve	1	198			
Stratum Vf	–	66			
Stratum Vg	1	88			
Stratum Vh	3	492			
Stratum Vi	–	87			
Total VI	1	115			
Stratum VIa	–	2			
Stratum VIb	1	73			
Stratum VIc	–	40			
Total VII	3	758			
Stratum VIIa	1	115			
Stratum VIIb	–	75			
Stratum VIIc	2	568			
Total	68	4909			

* Hajar at-Tamra, Strata III–IV: trace amounts as ‘large mammal’ fragments?

Working on Hajar ar-Rayhānī’s stratigraphy is complicated by the fact that the two successive reports use different phasing schemes, one based on ‘strata’ (Glanzman & Ghaleb 1987) and the second on ‘occupational phases’ (Glanzman 1994). The stratigraphy presented in [Figure 20.2](#) takes into account both reports, because, as explained below, ‘strata’ are still relevant for the needs of archaeofaunal analysis, although occupational phases are meant to supersede the previous scheme. Chronometric control is provided by ten radiocarbon determinations for Hajar ar-Rayhānī (Glanzman 1987a), some of them inconsistent because of their large standard deviations, and five for Hajar at-Tamra (Blakely 1985). A comprehensive catalogue with extended discussion is to be found in Glanzman (1994, 71–74, appx 2, and tabs 2.1–2.5); the datings for both sites are listed in a handy format in Edens and Wilkinson (1998, tab. viii and 94–95), who provide a useful commentary. However, intersite correlations based on pottery parallels raise questions. In a recent reappraisal de Maigret (2010) would equate Hajar ar-Rayhānī’s Strata VII–Ve with the 9th–7th centuries BC, a much shorter interval than Glanzman’s. This will affect the chronology and duration of the 3rd and 4th Occupational Phases, or Strata VI and lower V. In [Figure 20.2](#), a compromise has been attempted between the demands of stratigraphic inference, pottery correlation, and radiometric dating, but inconsistencies remain and cannot presently be resolved. Furthermore, de Maigret (2010) would put the end of Hajar at-Tamra’s sequence at 700 BC, explicitly admitting the considerable change in interpretation inherent in such a

revision. Any temporal evaluation of the faunal finds will depend on such divergences.

The 1984 faunal collection from Hajar ar-Rayhānī was studied in detail by Brian Hesse (1996a; 1996b; these papers are to some extent complementary). It totals 25,540 bones of which 19.2% were identified to species or genus. Overall, a fundamental reliance on sheep and goats is apparent (97% of the identifiable pieces), with cattle and camel each about 1–2% and gazelle and uncertain *Equus* (donkey?) in trace amounts. A much smaller sample from Hajar at-Tamra shows the same (see below). The stratigraphic distribution of camel finds is summarised for both sites in Table 20.3. It needs be noted that ar-Rayhānī’s fauna was published in terms of strata, not occupational phases. Metrical data are only available for ar-Rayhānī and comprise a mix of single-specimen measurements and group ‘bulk’ values (Table 20.4).

Table 20.4. Hajar ar-Rayhānī: summary measurements in mm, after Hesse (1996a, table 4, with corrections from his original manuscript dated May 1991; 1996b, table 8.04). Inferred anatomical specifications in square brackets, non-standard measurements as defined in Table 20.1. Added references are to Steiger (1990)

Hajar ar-Rayhānī: <i>Camelus dromedarius</i> and <i>Camelus</i> sp.						
Skeletal elements		LSI and size evaluation				
Single bones (n = 1)						
Femur	DC					
	48.8					−0.040
Astragalus	GLI	GLm	DI	Dm	Bd	
	70.7	64.2	40.5	40.5	48.0	−0.024
GB						
Os carpi intermedium	25.0					Within Steiger's (GBCi) 24.8±1.8
Os tarsi centrale	34.0					Very small
Os tarsale 2+3	39.3					–
'Fused os tarsale'	69.8					–
Bp						
Phalanx 1 [an]	44.5					+0.040
Grouped bones (n = 2)*						
GB						
Os carpi ulnare	48.0 ± 4.2					Range exceeds Steiger's (GTCu) 47.8±2.9
GB GL						
Patella	43.2 ± 2.5	91.8 ± 2.0				LSI from the means (43.2, 91.8) = +0.030; LSIs for individual bones (inferred size): +0.01 and +0.05, approximately
GL Bp Dp SD						
Phalanx 2 [an/po?]**	60.9	26.2 ± 8.6	28.3	34.9		LSI from Dp [anterior] = +0.037 LSI from SD [anterior] = +0.174 LSI from Bp [large, anterior] ~ −0.02 LSI from Bp [small, posterior] ~ −0.2+ LSI from GL [posterior] = −0.006

* Reported as mean value ± standard deviation.
** Limb position and individual measurements of each phalanx unspecified. The abnormally high standard deviation for Bp (if correct) points to extreme size difference between the

bones. The reported measurements are compatible with the presence of a large anterior phalanx (averaged LSI $\sim +0.064$) and a small posterior phalanx (averaged LSI ~ -0.11).

Within these limits, a biometric evaluation of Hajar ar-Rayhānī's measurements is presented in [Table 20.4](#). Only three bones can be assigned a precise LSI, but some further bones allow approximate size estimates. An interesting result, alongside the expected presence of domestic stock, is the appearance of animals that patently exceed the size range of the domestic dromedary ([Fig. 20.5](#)). A first anterior phalanx is probably from a wild animal (Bp = 44.5; LSI = 0.040), but a patella (LSI ~ 0.05) and especially a second phalanx (LSI ~ 0.064) might in theory indicate camel hybrids (see Köhler-Rollefson 1989 and Uerpmann 1999 for comparative data, and discussion under 'Barāqish' below). Unfortunately, a historical assessment is impossible because the stratigraphic provenance of the specimens is unpublished. Based on the urban context and a single astragalus with '*dromedarius*' morphology all camel material was attributed domestic status (Hesse 1996b, 272). Some foetal bones were present (B. Hesse pers. comm., October 1989).

Never a major faunal component (site frequency 1.39%), the dromedary increases from trace amounts (0.4%–0.9%) in Strata VII, VI and lower V, equivalent to the 2nd, 3rd and 4th Occupational Phases (9th–7th centuries BC, de Maigret's correlation), to 1.5%–2.3% from upper Stratum V (Vc) onwards, peaking at 2.3% in level Vc. The relative abundance of camel bones was calculated as a percentage of the pooled cattle-camel subsample, on the assumption that the two species do not co-vary; in another calculation the relative frequency was used (Hesse 1996b, 275). These statistics, and a consideration of the unidentified largemammal fraction, lead Hesse to suggest that there was a shift in camel frequencies towards the end of Stratum V and a threefold increase at the transition to Stratum IV (see also Edens & Wilkinson 1998, 106). Hesse is tempted to link this shift in relative representation to the advent of extensive overland transport based on camels. Hajar ar-Rayhānī was supposedly 'tied into the caravan network leading from Timna [Tamna'] toward Marib and points north' (Hesse 1996b, 263; cf Toplyn 1988, 102–103, for field data describing a relevant upland pass, with further comments in Glanzman 1994, 31–33).

A sudden increase from trace amounts to significant frequency appears at Hajar at-Tamra (Toplyn 1985; see also Fedele 2009, 147–149) ([Table 20.3](#)). The published data suggest that camel might be represented among the large-mammal fragments of Strata IV–III, but

its presence is only demonstrated from the base of Stratum II onwards, with a strong representation (3.6% of identified bones in Stratum II, 6.6% in Stratum I). The site's total shows that camel ($n=12$) comes second in frequency after the domestic caprines ($n=163$) and before cattle ($n=9$); however, as mentioned, the sample is small. Accepting de Maigret's correlation, the dromedary makes a signal appearance at Hajar at-Tamra as early as the 10th century BC (Fig. 20.2), a date which would be of remarkable interest if the domestic status of these few bones could be established.

Before conclusions are reached, see below, one also needs to determine how representative are the collections from Hajar ar-Rayhānī and Hajar at-Tamra. Concerning at-Tamra no information on recovery procedures was given; at ar-Rayhānī, on the other hand, the problem of 'collection intensity and bias' was carefully addressed (Hesse 1996b, 267–272). The overall sampling bias was examined in terms of size bias, taphonomic pressure, and differential bone destruction. Hesse concluded with confidence that 'the larger identifiable bones of small mammals and all the identifiable bones of medium-sized mammals and larger' were collected (Hesse 1996b, 269). However, some caution must be used in interpreting the relative frequency of species of significantly different size, and concurrently, 'the temporal integrity of bone deposits has been significantly distorted' due to the melting of mud-bricks containing old bone (Hesse 1996b, 272).

b. Hajar Ibn Humayd

This mound located in Wādī Bayhān, known in the literature as 'Hajar bin Humeid' (HBH), was the object of a pioneering excavation directed by William Foxwell Albright in 1950–1, as part of Wendell Phillips' AFSM expedition to southern Arabia. Unfortunately, disregarding more objective stratigraphic methods already practised elsewhere, HBH was largely excavated on the basis of arbitrary, horizontal dissection units, or 'absolute levels'. When the excavation was published long after the fieldwork was completed (Van Beek 1969), the stratigraphy was basically established through the seriation of pottery rather than well-defined physical layers (Blakely & Glanzman 1996, 3–4). The site's radiocarbon chronology, though elementary, filled a complete void of information and challenged datings based on subjective ideas of epigraphic style (see evaluations in Blakely 1985, 89; Edens & Wilkinson 1998, tab. viii). The HBH column in Figure 20.2 takes into account Glanzman's revision (1994, 538–547, tab. 2.6–2.8; see also Van Beek 1997) which, however, little

modified the earlier part of the sequence. Within the scope of the present paper, a good agreement exists with the pottery correlation established by de Maigret (2010).

Thanks to the detailed work on ceramics, the HBH monograph has remained for decades a regional landmark. Understandably, other information was below standard. The recovery of ecofactual evidence including bones was extremely limited. The one-page faunal report from HBH (Van Beek 1969, 289–290) describes eight mammal bones and some shells and coral, which were identified by three American zoologists, including Smithsonian Institution's HW Setzer as a mammal specialist (cf Fedele 1992, 71). It appears that animal finds were only picked up in the field when unusual and ancient, and owing to this practice two camel bones individually ended up in the sample, having been found in the two lowermost strata of the site. They were a vertebra and an astragalus, both determined as 'cf *Camelus dromedarius*' (Setzer in Van Beek 1969, 289–290, pl. 56: b). On pages 15 and 16–7 of the monograph, respectively, their contexts were outlined as follows:

The domestic character of this area [within Stratum S] is indicated by the presence of mortar, a clay spindle whorl, and a cervical vertebra of a camel (H3094).

Significant nonceramic finds [from Stratum R] include a fragment of a steatite cooking bowl with an iron rivet, which was used to repair an ancient break, and represents the earliest evidence for the use of iron at the site; a single specimen of a mollusk shell [...]; a fragment of faviid coral, which was probably kept in Building R: 1 as a souvenir; and the astragalus of a camel (H2815).

'The finding of camel bones in the two earliest strata, S and R' – Van Beek remarks at the end of the faunal report – 'indicates that the camel, *either wild or domestic*, was used as food' (1969, 290, emphasis added). A fragment of a clay figurine representing a camel's head was found in Stratum O, attributed to the 8th century BC.

c. HR3, HT12, HBH: results

Hajar at-Tamra and Hajar Ibn Humayd, within the limits of their coarse-grained chronology, clearly hint at the existence of habitual human–camel relationships in Yemen in the 10th century and possibly as early as the 11th century BC. The main drawback concerning these sites is the impossibility of establishing whether the camel bones derived from wild populations or domesticated stock. The contribution of these sites in terms of chronology is thus – for the moment – considerably diminished by the indeterminacy of the human behaviour involved. At Hajar ar-Rayhānī the evidential basis is in a way the opposite: we may be dealing with a majority of animals

which are osteologically domestic, according to the published measurements, but we lack information on their stratigraphic position and individual chronology. The collection was implicitly treated as corresponding to a homogeneous suite of domestic populations, on the assumption that the archaeological context suggests a domestic condition throughout the sequence. This is not the case, however, since a few bones would fall unequivocally within the range for the wild dromedary. Although the chronology of these bones is unreported, one can infer that during the lifespan of the city episodes of camel predation coexisted with camel husbandry. Similar observations from Barāqish will be discussed below.

Barāqish (Yathill)

Ancient Yathill, now known by its Arab name of Barāqish (de Maigret & Robin 1993; Robin & Brunner 1997), is one of the largest walled Iron Age cities of the Jawf Valley, in the northern predesertic belt of Yemen ([Fig. 20.1](#)). The walls are Minaean in origin (6th–3rd centuries BC; de Maigret 2004; de Maigret & Robin 1993; Fedele 2010), famously the best preserved in southern Arabia, and enclose an area of 4ha. Surface finds, mechanical corings, and the excavations currently in progress suggest that the Minaean city was preceded by an even more substantial Sabaean settlement. In particular, a stratigraphic testing outside the walls in 2005–6, excavation Area C, revealed a long sequence of occupations spanning the whole 1st millennium BC (Fedele 2010). Concurrently, a vertical sounding 8m deep within the city produced evidence of Sabaean occupation from as early as the 13th century BC, without reaching virgin soil or bedrock (excavation Area A, sounding A/S1, 2006; de Maigret 2010). These two stratigraphic columns are shown in [Figure 20.2](#). Only Area C, indicated as ‘C/S1’, is of interest here.

In the Area C excavations ([Fig. 20.7](#)) a stratigraphic section was obtained by digging a radial, stepped trench down and away from the Minaean wall. The trench cut deeply into the talus surrounding the tell and expanded beyond the footslope into the adjacent plain, providing an essentially continuous cutting 52m long and 14m deep. In addition, an isolated test pit was sunk 30m away in the plain. At the upper end of the section, a sounding along the wall reached a depth of 8m and for the first time brought to light the base of the Minaean enclosure, revealing that it rested on Sabaean occupation deposits. The chronological control is assured by eleven AMS radiocarbon determinations, which indicate the 8th–7th centuries bc for the core of the Sabaean occupation (Fedele 2010, table iii and fig.

9). The deepest Sabaean levels from the lower part of the trench are yet undated, but on the basis of stratigraphic correlation can safely be attributed to the 9th–8th centuries BC (Figure 20.2).

Well-preserved animal remains have been systematically retrieved from both stratigraphic sequences, numbering several thousand pieces from Area C alone (de Maigret 2010; Fedele 2010). In addition, dung levels and coprolites characterise a number of Minaean layers in Area C. Only an interim account of the bone assemblages from this area can be given at this stage of study, because continuation of the faunal analysis undertaken in 2007, and work at the site in general, have been impossible. The results are summarised in Table 20.5, where the species composition for the Sabaean and Minaean periods is presented, accompanied by a qualitative indication of relative frequencies. Camel remains (Fig. 20.8) are fairly common and increase over time. Because of working-time constraints only a few bones could be measured, and a metrical (Table 20.6) and contextual evaluation will be made in this section. In spite of their paucity, as discussed below, the available data clearly bear on matters of early camel management.

Overall, the archaeofaunal picture from Sabaean Yathill closely matches Yalā’s and Hajar ar-Rayhāni’s. The economy relied heavily on domestic caprines – sheep and goat – and taurine cattle. The donkey was present. The high frequency of cattle points to a local oasis environment, sufficiently rich in pasture and probably still sparsely wooded, although the broader setting of the city was a semi-desert according to sediments. Additional similarity between Yathill and other Sabaean cities along the desert fringe comes from the fact that evidence for the hunting or capture of wild animals is very scanty, and game species are virtually nonexistent at Yathill. However, a humerus from a wild camel, a unique find for the site, deserves special mention (see no. C.151.1, below)

Table 20.5. Barāqish Area C, over-wall excavations: preliminary species list for the Sabaean and Minaean phases (from Fedele 2010, table 8). The number of “×” is proportional to the frequency of finds; / = traces; 1 = a single find

Barāqish C/S1, 2005-06		
	Sabaean	Minaean
	kitchen/butchery refuse (often burnt or roasted)	refuse from meals, some from trading camps? (cutmarks, trampling)
DOMESTIC ANIMALS		
Sheep & goat (both)	× × × × ×	× × × × & coprolites;

hornless sheep

Cattle, Bos <i>taurus</i>	× × × × ×	× × × × ×
Dromedary, domestic	× ×	× × × & coprolites
Donkey	× & coprolites	× × ×
Dog, small	/	/
Domestic fowl, ? <i>Gallus</i>	/	
? <i>Mule</i>		/ [horse x donke hybrid?]

WILD ANIMALS

<i>Camelus</i> sp. wild	1 [C.151.1, quadr. E11]	?
Gazelle, <i>Gazella</i> sp.	?	/
? Ibex	1 abraded talus [an artefact from <i>F1</i>]	
Ostrich [bones]		× & 2 eggshell frags
Cypraeids, marine shells	/	1 [from sounding <i>F1</i>]
cf. <i>Arca</i> , marine shell		1 [from sounding <i>A</i>]

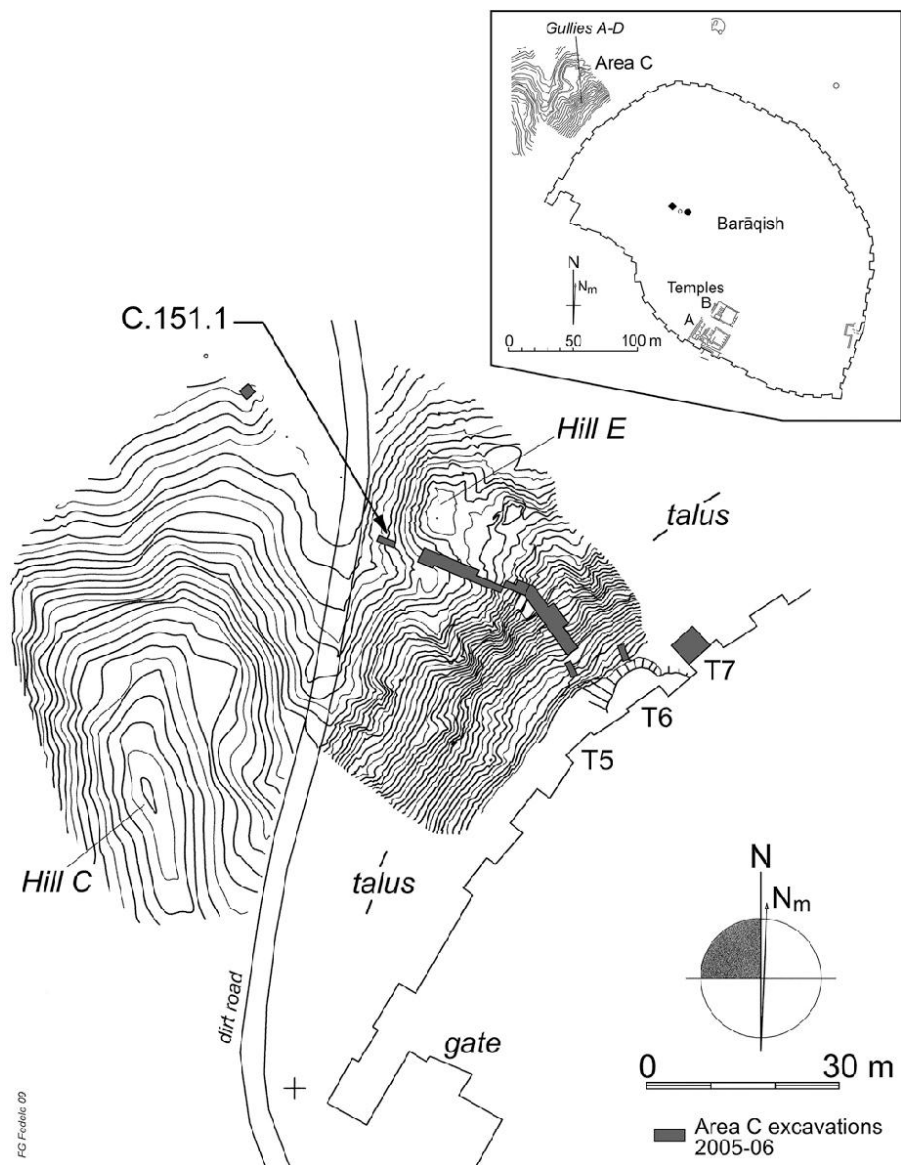


Fig. 20.7. Barāqish Area C, plan of the over-wall excavations 2005–6 (after Fedele 2010, with additions). The arrow marks the findspot of camel humerus C.151.1.

Table 20.6. Barāqish Area C, over-wall excavations: a selection of *Camelus* bone finds. Measurements in mm, with estimates in parentheses, as defined in von den Driesch (1976) and in Table 20.1 (accessory measurements). LSI is the averaged logarithmic size index

Sabaeen 3 (7th century BC)									
Find no.	Grid and layer	Skeletal element	Measurements						LSI
			<i>Bd</i>	<i>BT</i>	<i>SD</i>	<i>HT</i>	<i>HTC</i>	<i>Dd</i>	
C.151.1	<i>E11</i> : H11, Locus 151	Humerus, di	101.6	89.3	(53)	68.3	46.0	(87)	+0.045
			<i>GLV</i>						
C.199:41	<i>A1–A31</i> E: SYH	Rib fr	52.2						
C.199:42	<i>A1–A31</i> E: SYH	Rib fr, head fusc	51.5						
Minaean 1, counterfort fill (6th–?5th century BC)*									
			<i>GL</i>	<i>SD</i>	<i>Bp</i>	<i>BFp</i>	<i>Dp</i>	<i>Bd</i>	
C.195:1	<i>A1–A31</i> : T79J	Phalanx 1 ₃ , an	102.3	(19.5)	39.8	–	–	–	–0.015
C.195:2	<i>A1–A31</i> : T79J	Phalanx 2 ₃ , an	62.8	26.9	32.6	30.2	24.4	34.5	–0.045
C.190:45	<i>A1–A11</i> W: T77 etc.	Phalanx 1 an, px	–	–	44.1	–	38.0	–	+0.034
			<i>P_E: Lo</i>	<i>P_E: Bo</i>	<i>M₁: Lo</i>	<i>M₁: Bo</i>	<i>M₂: La</i>	<i>M₂: Ba</i>	
C.195:2–3	<i>A1–A31</i> : T79J	Mandible, fr + rM	–	–	–	–	40.1	19.3	
								<i>H_{PM}</i>	
C.194:5	<i>A1–A11</i> : T79L	Mandible _g + P–M	22.5	9.8	39	(19.5)	42.2	(48)	
			<i>Bp</i>	<i>Dp</i>					
C.190:46	<i>A1–A11</i> W: T77 etc.	Metatarsal ₄ px	59.0	44.3					–0.015
Some additional finds			Chronology, remarks						
C.112:1	<i>E3</i> : S13, PV3, ?V3	Phalanx 3	Sabaeen 1: ca. 820–700 BC.						
C.102:1	<i>E2</i> : V3, SE3, S11	Metacarpal, J	Sabaeen 1–2: 8th century BC.						
C.39:1	<i>D5</i> : GK4	Phalanx 1, pathol.	Sabaeen 3 (1): ca. 650 BC.						
C.151:02	<i>E11</i> : H11–H11 ₀	Humerus ₄ px fusc	Sabaeen 3: 7th century BC. Roasted.						
C.151:01	<i>E11</i> : H11–H11 ₀	Ulna, fr	Sabaeen 3: 7th century BC. Roasted.						
C.198:4	<i>A1–A31</i> : AR–T7Z1	Humerus di fr	Minaean 1, foundation trench of the wall (6th–?5th century BC).*						
C.198:5	<i>A1–A31</i> : AR–T7Z1	Epistropheus fr	Minaean 1, foundation trench of the wall (6th–?5th century BC).*						
C.191:7	<i>A1–A31</i> : T77u	Radius, px fr	Minaean 1, counterfort fill (6th–?5th century BC).*						
C.189:74	<i>A1–A31</i> : lower T7LP	Pubis, frs, fusc	Minaean 2: 5th–3rd century BC.						
C.188:4	<i>A1–A31</i> : upper T7LP	Humerus di fr	Minaean 2: 5th–3rd century BC.						
C.188:5	<i>A1–A31</i> : upper T7LP	Metacarpal di fr	Minaean 2: 5th–3rd century BC. Metal tool cutmarks.						
C.185:16	<i>A1–A11</i> : TSR–T76	Astragalus fr	Minaean 3: 2nd–1st century BC. Carbonised.						
C.185:18	<i>A1–A11</i> : TSR–T76	Mandible fr + rM	Minaean 3: 2nd–1st century BC.						
C.211:1	<i>F1</i> : F02 etc.	Humerus di fr	Minaean 3–4: 2nd–1st century BC. Sandblasted.						
C.184B:2	<i>A1</i> south: lower T75	Cervical vertebra	Minaean 4: 1st century BC. Dorsocaudal fr.						
C.183:1	<i>A1–A11</i> : T74K–T74η	Mandible + P–M	Post–Minaean interval: 1st–?2nd century AD						
C.184.2	<i>A</i> south: upper T75	Whole coprolite	Minaean 4: 1st century BC.						

* Most bones from the foundation trench and some from the fill of the so-called counterfort are reworked Sabaeen 3 material (ca. 650–600 BC; see Fedele 2010).

Osteology codes, in alphabetic order: an = anterior; d/s = right/left; di = distal; fr/frs = fragment/s; fusc = fusing; J = juvenile; px = proximal; rM = root of molar tooth; 3 = third or axial toe (phalanges)

A key information from Barāqish is the dromedary's earliest appearance in the Sabaeen 1 phase of the over-wall sequence, from the turn of the 9th to 8th century BC (Stratum T in Figure 20.2; see Fig. 20.8 and Table 20.6 for bone examples, e.g. C.112:1, C.102:1). Equally interesting is the evidence that camels were commonly present throughout the sequence. More difficult to establish at this stage of research is the particular economic basis underscoring the occurrence of camels during each period. Clearly, the dromedary was butchered and consumed. And here again, like at Yalā and elsewhere, this species is presumably under-represented in terms of actual remains, therefore resulting in a defective picture. An animal kept for

nonfood purposes, especially one not frequently consumed, may leave comparatively fewer remains (Ermolova, NM 1970, cited in Compagnoni & Tosi 1978, 100; Horwitz & Rosen 2005, 128; Köhler 1984, 201). During at least the local Later Sabaean (7th century BC) and the subsequent Minaean, when the archaeological indications of trade become more evident, the greatest part of the dromedary bones at Barāqish probably derive from transport animals subsequently utilised as a food source (like at Tell Jemmeh, Israel, for instance; Wapnish 1984, 179). Herd assessment is not yet available, nor is – in particular – sex and age profiles for individual strata or periods. This information will certainly be forthcoming from both the city and the over-wall excavations at a future stage of study.

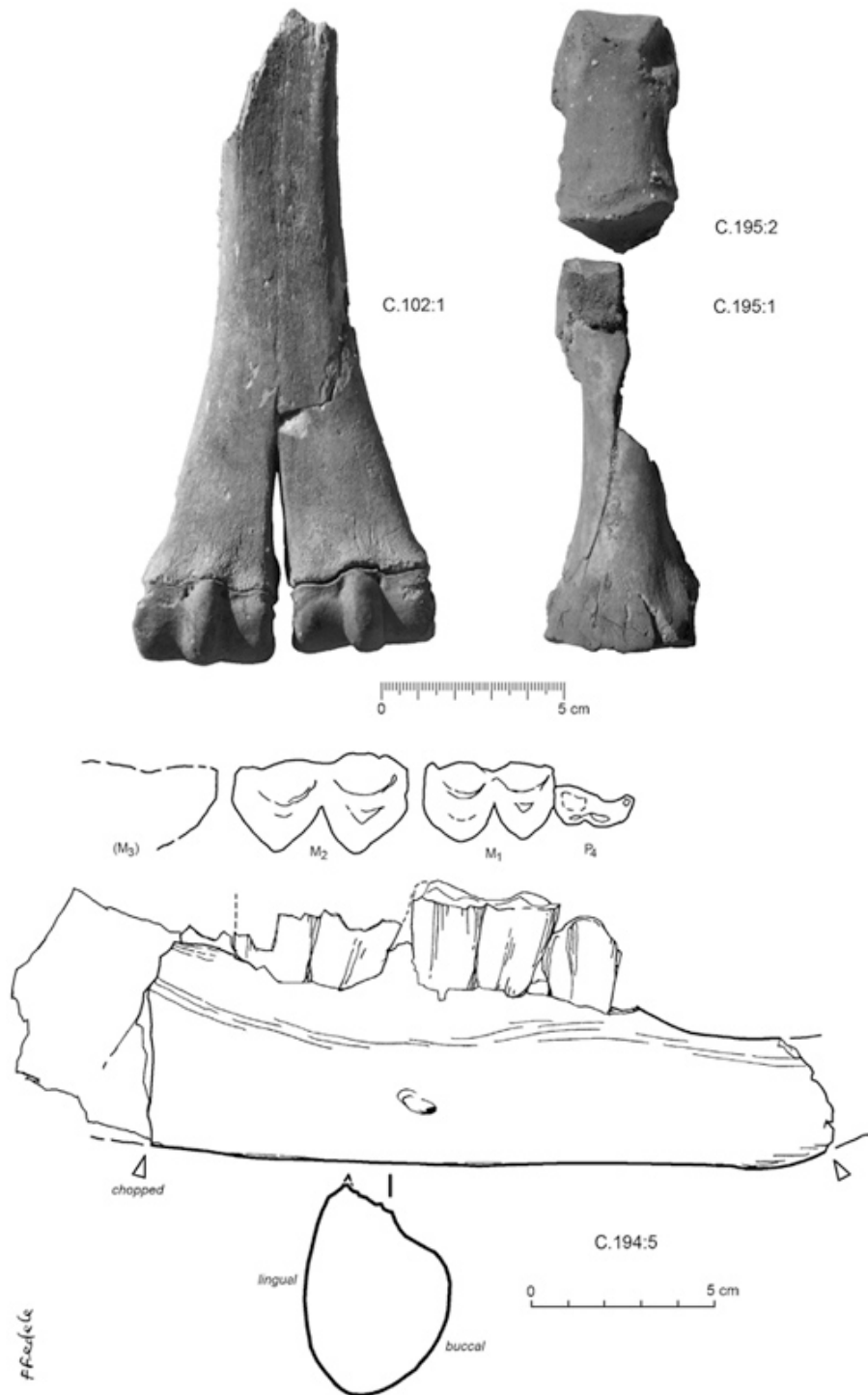


Fig. 20.8. Barāqish Area C, over-wall excavations. *Camelus dromedarius*: juvenile metacarpal C.102:1; 1st and 2nd anterior phalanges 195:1, 2; right mandible C.194:5.

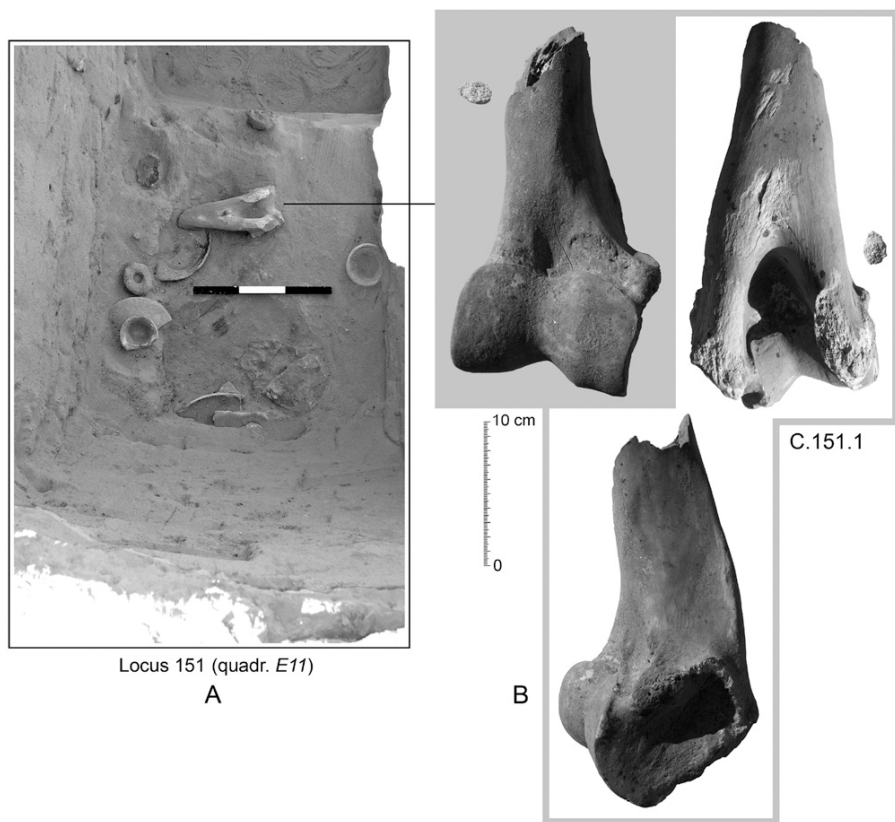


Fig. 20.9. Barāqish Area C, over-wall excavations (2005). A: Locus 151 in quadrangle E11, with Sabaeen pottery and dromedary humerus, as exposed. B: Camelus sp. wild, humerus C.151.1.

Logarithmic size indices were calculated for five bones, one belonging to the Later Sabaeen and four to the fill of a ‘counterfort’ associated with the Minaean wall construction (Table 20.6); most bones from this fill, in fact, might be reworked Later Sabaeen elements. The comparisons with the Arabian biometric records of Figure 20.5 show that three Minaean bones fall within the domestic range (first anterior phalanx and proximal metatarsal, both $LSI = -0.015$; second anterior phalanx $LSI = -0.045$). Taken together they provide an osteometric mean of -0.025 , virtually identical to the value for Muweilah, Iron Age II (Uerpmann & Uerpmann 2002). On preliminary inspection most of the camel bones appear to be osteologically domestic throughout the Barāqish sequence.

Another first anterior phalanx (C.190:45) has instead an LSI of 0.034 , which suggests a much heavier build. The plausible alternatives

point to a wild or a feral animal, while the relatively early dating would rule out a camel hybrid. Whether feral camels roamed the Jawf during the Earlier Minaean period cannot be determined. It is safer to think of a wild animal, like at Hajar ar-Rayhānī (see above) or at Muweilah, where in a context generally similar to Barāqish' some bones fall in the range of the wild Bronze Age camels. As to the theoretical possibility of a hybrid, the view is generally accepted that the practice of crossbreeding did not begin earlier than the 2nd century BC, during the Parthian period (Bulliet 1990, 141–170; Köhler-Rollefson 1989; Potts 2004; 2005). Bactrian-dromedary hybrids were identified for the first time in Arabia at Mleiha (Fig. 20.1) in a graveyard probably dating from the 1st or 2nd century AD (Uerpmann 1999; see Mashkour 1997 for the graveyard context). Phalanx C.190:45 is slightly smaller than Mleiha grave 4 (Bp = 44.8, Dp = 38.5) and below the Bp range of the hybrids from Pella (46.0–51.3; Köhler-Rollefson 1989, tab. 16). Since the bone is incomplete, a comparison with Uerpmann's (1999, fig. 9) GL/Bp scattergram is not possible.

The case for a wild dromedary can be confidently argued for C.151.1, a distal humerus from a findspot on the outskirts of the Later Sabaean settlement, bordering the plain (Fig. 20.9). The same archaeological cluster, Locus 151, which as part of Stratum M can be dated within the 7th century BC, contained two more forelimb fragments of *Camelus*. In size and surface appearance the humerus is very different from all other camel material from the over-wall excavations. Its LSI of 0.045 (Fig. 20.5 & Table 20.6) leaves no doubt that this large bone belongs to a wild animal of dromedary morphology. The bone was chopped by heavy percussion and partially roasted, resulting in a reddish hue on its anterodistal part, while the orange pigmentation on the rest of the bone is somewhat unusual. The other bones from the locus are roasted as well.

The humerus, together perhaps with phalanx C.190:45 above, is of particular importance because it indicates that populations of wild dromedaries still existed in Yemen during the mid-1st millennium BC (cf Uerpmann & Uerpmann 2002, 257, speaking of the U.A.E.), when the domestication of the species had been under way for a long time in the Arabian Peninsula, including Yemen (this study), and was being perfected. Such populations may have survived much longer, since rock depictions of what have been interpreted as wild camels (e.g. Peters 2001; Spassov & Stoytchev 2004; Zarins 1989) continue to be found in southern and central Arabian contexts as late as the 2nd and possibly throughout the 1st millennium BC (see Khan 1998 and

Bednarik & Khan 2005 for a redating and the concomitant demonstration that previous chronological claims were unfounded). The wild population inferred by humerus C.151.1 may be located in the wider area of Barāqish, but this is unsure. Although the bone may be a result of episodic hunting by residents of Yathill, it might, alternatively, derive from a chance encounter with a wild herd in the course of travel or caravan traffic, and thus have been brought in from greater distance for meat.

From this perspective it is significant that the general context of the find suggests a tent campsite outside the settlement, one in a long series of such traces stratified on the plain along the footslope of the talus (Fedele 2010, 125, 147–148). At Locus 151, the composition and condition of materials do not suggest ‘normal’ kitchen refuse. Rather than intensive occupation they indicate repeated episodes of activity in the open, possibly associated with light-shelter constructions. The archaeological association – cooking pots, tripods, pans, evidence of burning, ‘torpedo-type’ trading jars – combined with what looks like a patchy distribution of activity clusters, suggests a scenario of bivouacs or tents on the plain (cf Cribb 2004, Saidel 2009, and several contributions in Bar-Yosef & Khazanov 1992, for the relevant interpretive framework). Some unusual or exotic items may further suggest that foreign parties – merchant caravans? – were possibly involved. If trade, unsurprisingly, was a pivotal factor in Yathill’s *raison d’être*, the over-wall excavations provide first-hand evidence for it as early as the lowermost Sabaeen strata: ‘torpedo’-jar handling, pack animals, exotic items, camping in tents. The subject has been developed elsewhere (Fedele 2014).

In this context, it may be of interest briefly to explore the theoretic possibility of similarities – if not outright exchanges – between the Jawf node in the trade routes and southeast Arabia. Muweilah, in particular, enjoyed a broadly symmetric position to Barāqish across the expanse of southern Arabia, relative to the desert margin (Fig. 20.1). With its *floruit* in the 9th century BC, Muweilah should be singled out because the growth and functioning of the city as reconstructed by Peter Magee (2004; 2007) may indeed suggest analogies with Earlier Sabaeen Barāqish in spite of their cultural differences. For instance, Muweilah has revealed among its long distance connections some obvious contact with the Sabaeen area (a pottery vessel with South Arabian script; Magee 1999). One can further note that the dromedaries from Muweilah, on present evidence, were slightly heavier than those of contemporary Tell Abraq on the coast (Magee 2007; Uerpmann & Uerpmann 2002). If a

different camel type or ecotype was indeed circulating at Muweilah, this might hint to selection and/ or participation in a different network. (On ‘pack’ types and other specialised camel variants see Wilson 1997.) The possibility that animals travelled along east-west or ‘transverse’ Arabian routes, together with information and goods, probably deserves consideration. Incidentally, any transverse contact may have helped spreading camel domestication at the beginning of the 1st millennium BC within central-southern Arabia itself (see next section). Future research is needed to test such propositions.

At Barāqish, like at Yalā, all the suitably preserved camel finds show a ‘*dromedarius*’ morphology. There is certainly no reason to classify the remains from domestic animals other than the Arabian species. For instance, a mandibular body (C.194:5; [Fig. 20.8](#)) exhibits the relatively rounded cross-section in proximity of the diastema which characterises at least the older individuals of the dromedary (Uerpmann & Uerpmann 2008, 102). The specimen or specimens that in terms of the LSI lie in the commonly accepted range of the wild dromedary raise a nomenclature problem, due to this wild progenitor still lacking a name, and ‘*dromedarius*’ being ruled out by the International Commission of Zoological Nomenclature (Gentry *et al.* 2004). Following Uerpmann and Uerpmann (2008, 102–3) the noncommittal label ‘*Camelus* sp.’ is here employed.

Discussion and conclusions

Evidence from Yemen

Pending further work at Barāqish and hopefully elsewhere, the above information is fragmentary, but at the same time sufficient to signal early camel domestication from Yemen. *Prima facie*, Hajar Ibn Humayd and the Wādī al-Jūbah sites could be discounted for lack of anatomical and/or stratigraphic information. However, combined with circumstantial evidence, the relative frequency data reviewed above may well indicate a degree of camel management in Wādī al-Jūbah as early as the 10th century BC (Hajar at-Tamra). This is matched by the data from the main local centre, Hajar ar-Rayhānī, allowing for the domestic status of three camel bones found in Stratum VII, or the 1st and 2nd Occupational Phases (10th–8th centuries BC).

A firmer testimony to the presence of domesticated dromedaries is provided by the Early Sabaean settlements at Yalā and Barāqish. These sites suggest that between about 850 and 650 BC camels under cultural control had become common in a part of Yemen. In fact, the animals had already become sufficiently numerous by the late 9th

century BC for their remains to be found consistently among food refuse in Sabaean cities along the semidesert belt. The two cities provide sufficient evidence to suggest that dromedaries were employed both on the main caravan traffic routes (Barāqish) and at a distance from them (Yalā). Furthermore, a 9th century BC date for the domesticated dromedary in Yemen compares well with its definite appearance in southeast Arabia ca. 900 BC (Magee 2007; Uerpmann & Uerpmann 2002).

A provisional ‘first appearance datum’ (FAD) is thus indicated for the domestic dromedary in Yemen. FADs are among the primary datum events by which biochronology on a regional scale is constructed. ‘The FAD of any particular species in a certain geographic area usually is considered due to either the in situ evolution of the species from an ancestral form or the immigration of the form [i.e. the species] from another area’ (Schoch 1989, 201). While important, FADs also require caution when used historically in zooarchaeological contexts. Two aspects are relevant. Once a species has evolved, it may take a certain amount of time to spread throughout what will eventually be its total geographic range (the ‘prochoresis’ process), and it may also take time to become sufficiently numerous in its range so that its remains will regularly appear in the record (Schoch 1989, 202). The second aspect has to do with site formation – what material remains will end up in the record and be preserved, and how. In addition to the usual biases (Chang & Koster 1986; Kent 1987; Schiffer 1996), specific cultural-functional biases may have acted in the case of the camel. For instance, reference was made above to its defective representation among food residue. But although sporadically mentioned, the issue is in fact unexplored. These selective and distorting factors may combine to produce an apparent, ‘archaeological’ FAD for the domestic dromedary that differs more or less significantly from a ‘true’ FAD in any given locale.

All Yemen finds come from urban contexts (Fig. 20.1). Like elsewhere in the arid parts of Western Asia, there has been a bias against locating such archaeological sites as ephemeral camps or trade-route stations, and that translates into a lack of bone finds from similar contexts, camel finds in particular (although current work by W Glanzman [2004b] may redress the balance; see Bar-Yosef & Khazanov 1992 and Szuchman 2009 for potential approaches). Thus a presumably large part of direct evidence for the early, specific handling of camels is missing. On the positive side, initial work at Barāqish/ Yathill has begun to connect camel remains directly to Sabaean and subsequently Minaean archaeological trade contexts,

from at least the 8th century BC. A city that played a pivotal role in caravan trade represents a privileged site. In addition, the Yemen evidence contributes to charting the distribution of wild dromedary populations in space and time, well into the 1st millennium BC. This is of particular interest if one considers that until very recently the wild ancestor of the Arabian camel was unknown in the Peninsula (compare, e.g., Köhler 1981, 129, with Uerpmann & Uerpmann 2002). The co-occurrence of wild and domesticated animals at such locales as Barāqish or Wādī al-Jūbah suggests repeated if not habitual interactions with wild camel populations. However, it is impossible to ascertain the frequency and modes of interaction, or the distances at which wild camel herds were found.

Optimally, the ascription of domestic status to camel finds must rely on a combination of body size and proportions (including use of index scaling techniques), faunal composition, and archaeological context, basically in this order. Data from Yemen that support a domestic-status interpretation have been reviewed with due qualifications concerning biometric or chronological aspects. On the other hand, the information is still defective in several areas, and the bone finds are insufficient to derive useful age profiles – a severe limitation. As an approximation, the presence of immature or even foetal animals was noted when possible. To mention another glaring deficiency, large bodies of individual metrical data are clearly needed in order to document the emergence and evolution (if any) of camel domestication. The example set by the Uerpmanns in southeast Arabia cannot presently be matched in the southwestern part of the Peninsula.

The problem of dromedary domestication

Knowledge on the domestication history of the dromedary is not only scanty but controversial. Several fundamental issues are unresolved, and, in particular, ‘the date and location of camel domestication is still much debated’ (Magee 2007, 94; cf Kitchen 1997, 135). A faunally wellstudied area, the southern Levant, including the Negev Desert and the Sinai Peninsula, has often been used to monitor the emergence of domestication in Arabia or the adjoining regions. From this observatory an interpretation can be advanced that expands and in part supersedes more conservative reconstructions. Its strength derives from a particular convergence of bone data, imagery, and historical-political context, with due allowance for an uneven archaeological visibility of initial camel use.

This interpretation depends on the cultural status of the camel bones found in large quantity at some sites in the famous mining area of Timna', Negev (Rothenberg 1972, 105; 1997, 28; 1999; 2003; Rothenberg & Glass 1983, 122; see also Grigson 1998, 259; Zarins 1989, 148–149). The context is dated to 1300–1150 BC by the materials and structures associated with the Egyptian control of copper-ore exploitation, which climaxed during the reign of Ramesses III, 1184–1153 BC. The workers included Negevite pastoral groups and 'Midianites' from northwest Arabia, these latter representing a polity of the northern Hijāz roughly associated with the Qurayyah painted ware (de Maigret 1999; Edens & Bawden 1989; Knauf 1988; Levy 2009a, 255–257; Parr 1982; 1992a; 1992b; Rothenberg 1998; Sawyer & Clines 1983; Tebes 2007). Although donkeys were common, the Midianite miners 'already used many camels': 'supplies were actually brought over from the Hijaz on camel-back, [and] camels were also widely used as pack animals in the mines and smelters' (Rothenberg 2003, 14). Large camel-meat consumption might of course be related to large wild herds in the area – a cheap larder – rather than to a surplus of pack animals. However, if the above claims are substantiated, a thoroughly specialised use of camels will be demonstrated already in the 13th–12th centuries BC (Artzy 1994; Edens & Wilkinson 1998, 105–8; Finkelstein 1988; 1995, 103–126; Holladay 2001, 175; Knauf 1988, 14–15; Wapnish 1997; different views in Barako 2000; Retsö 1991). This interval corresponds to the Late Bronze II and Iron I sequence of the Levant and the Ramesside period in Egypt (for a discussion of Egypt's impact on regional or Arabian trade see Tebes 2008 and Wengrow 1996, with bibliography).

While the zooarchaeological details from Timna' (cf Rothenberg 2003, 14) are eagerly awaited, the contextual evidence looks compelling, as it joins other independent indicators that domesticated camels were known or used in that general context and period. Sparse but credible pictorial data come from northwest Arabia as well as Ramesside Egypt (Budka 2004; Ingraham *et al.* 1981, pl. 79: 14; Kitchen 1980; 1997, 135 and n. 22, *contra* Midant-Reynes & Braunstein-Silvestre 1977; Pusch 1996; Saber 1998; worth reading is the original statement by Petrie 1907, 23, on the water-bearing camel figurine from Dēr Rifeh). The Hijāz-Negev-Sinai region might even emerge as a potential centre of dromedary domestication. The marauding of the southern Levant by Midianite 'nomads', famously echoed in Judges 6:4–5 (see Barako 2000, 520, on this passage's chronology), is symptomatic of the initial consolidation of camel riding in Iron Age I, perhaps as a response to horseback warfare (the

Dromedarkriegertum hypothesis, Dostal 1967; cf Uerpmann & Uerpmann 2002). Furthermore, a scenario defined by rapid state emergence in southern Arabia and growing communication between this region and the Levant is apparent by 1200 BC, inevitably implying desert travel by use of dromedaries, as articulated by Kitchen (1997, with references). Half a century later Egypt was acquiring her supply of incense and other south Arabian aromatics by overland trade, no longer by sea, as did other expanding markets in the Near East. However, until about 1000 BC skilled camel use may have remained restricted to particular groups, areas or networks, giving the archaeological impression of 'low numbers and/or slow acceptance' of this animal (Horwitz & Rosen 2005, 126).

With the 10th century BC (Iron Age II) camel bones begin to be commonly found in archaeological sites of the southern Levant in contexts normally implying camel control, such as caravan-linked Tell Jemmeh or Beersheva (Hakker-Orion 1984; Köhler-Rollefson 1993; Wapnish 1983; 1984, supplemented by Hesse & Wapnish 1985, fig. 87; see a recent summary, Timna^{excluded}, in Horwitz & Rosen 2005, table 2). As the exploitation of wild camels has been shown to persist later than thought, an osteological verification on a case-by-case basis is essential. More dubious still is attributing domestic status to camels depicted in petroglyphs (e.g. Khan 1993; Younker 1997). That the 10th century was especially significant, as suggested by the bone evidence, is strongly supported by texts and imagery from the wider Near East. The domestic dromedary unambiguously appears in two famous reliefs of a camel and rider from Karkemish and Guzana (today Tell Halaf) in northern Syria, presently dated to the 900 ± 30 BC interval (Genge 1979; Hawkins 1980; Winter 1983; see also Gerlach 2000). In addition to their chronology, a combination of ideology, economic-political context, and sheer distance from Arabia gives them special interest. Repetition makes the camel-and-rider a standard motif, suggesting that by the late 10th century the subject had acquired iconic value from both its novelty and visual impact.

Economically, these north Syrian polities were tied into a network which ostensibly had in the city of Khindānu on the middle Euphrates its main 'outlet' for Arabian products, hence Arabian innovations, as cogently argued by Liverani (1992; Holladay 2006; Kitchen 1997, 134–135; Na'aman 2007). According to cuneiform sources these goods included dromedaries, antimony, alabaster and myrrh; this last also traded northwards (Liverani 1992, fig. 1). Such commodities and network imply that by the mid-10th century caravan-cities were flourishing in Yemen and western Arabia, and further suggest that a

direct crossing between this latter region and the middle Euphrates was perhaps normal (Liverani 1992; cf de Maigret 1997; 1999; Holladay 2006, fig. 2). From about 890 BC onwards the Arabian contributions are repeatedly confirmed by Assyrian texts (e.g. Grayson 1991, 175 [where the context supports the identification as 'dromedaries']; 1996; Cavigneaux & Ismail 1990, 346–357; Eph'al 1997; Frame 1995, 300; Retsö 2003, 121–129; Lanfranchi 2004; see also Bulliet 1990, 77 ff.). Here the dromedary enters 'history' as an animal to be ridden, an object of prestige increasingly involved in tributes and exchanges. Immediately afterwards – mid-9th century – it emerges as a uniquely important beast of burden, not only critical for the Arabian mastery of desert transport but useful in war (as first depicted on the Balawāt bronze gates; for the Assyrian stone reliefs see Mitchell 2000). As mentioned above, this is the very time frame in which the osteological evidence indicates a beginning of dromedary husbandry in southeast Arabia (Magee 2007; Uerpmann & Uerpmann 2002; 2008).

Several influential authors have argued for a long 'prehistory' of dromedary domestication, rooted in the familiarity of people and dromedaries in parts of southern or central Arabia resulting from habitual propinquity (e.g. Bulliet 1990, 58–65; Dostal 1958; Köhler 1981; 1993; Wapnish 1983, 104; Uerpmann & Uerpmann 2002; Zarins 1989, 148–149; 1992a; see also Borowski 1998, 112–121; Finkelstein 1988). In this perspective, herding would have been a final outcome in a limited number of suitable enclaves, presumably with marked regional differences (cf Dostal's [1958; 1967] distinction between southern and northern Arabia, or Kitchen's [1997, 127] justified contention that there are 'two Arabias, culturally and historically – East and West'). Specialised exploitation of the dromedary for long-distance transport may have been a closely related development, favoured if not ignited by a new international scene as discussed above. Suitable body types would have been selected – and equipment created – for particular tasks, such as carrying goods, or as a war mount on the northern Arabian fringe (Köhler-Rollefson 1993; Sweet 1965a; 1965b). In all probability, the core novelty from a cultural viewpoint was a broader process: the mastery of the desert, the unprecedented human use of its space and biome. This, I would suggest, is the backcloth against which the still modest faunal data from Yemen have to be set.

In terms of both ecology and geographic position the Yemeni Sayhad, at the broad interface of foothills and desert, would be ideally

located for nurturing a large biomass of wild *Camelus* as well as proximity of camels and people. It is not a minor factor that camels need salty desert or semidesert shrubs (e.g. Khazanov 2009, 123; Köhler-Rollefson 1991; Wilson 1984), such as abound in the Sayhad (Wood 1997). The association of the Sayhad with interregional dromedary traffic, and the trade of aromatics in particular, may thus have emerged as a local development, based on a longer preparation than normally acknowledged. Here the highly organised kingdom of Saba' was best placed to exploit this phenomenon, shortly heading a federation of caravan-cities (early 10th century BC minimum on a ca. 680 BC date for Karib'il Watār I; cf Kitchen 1997, 151); T. E. Levy's (2009b) model for the emergence of a 'chiefly confederacy' in a similar context may be relevant here. If there was in the 13th–12th centuries BC a domestication enclave in the 'Midian'-Negev area, linked to desert travel, one could venture the idea that camel use rapidly developed as a desert-border specialisation along the whole belt of western Arabia, with Yemen as its main southern focus at the same date (cf Zarins 1992b). This in principle would justify theories of Yemen's important role in camel domestication. Camel bone finds from exploratory surveys in interior Saudi Arabia (the southern Nejd; Zarins 1989, 148, with references) have a bearing on this possibility and suggest great potential for future research.

Concerning Yemen, only further archaeological work on both urban and non-urban sites of the Sayhad, supported by archaeofaunal analysis, will allow this set of hypotheses to be tested. At present, in general, any attempt to chart the spread of the domesticated dromedary in southern Arabia is hampered not only by the dearth of zooarchaeological reports, especially for the earlier periods, but by chronological deficiencies. If, predictably, a great deal still awaits to be discovered about Yemen's record of early camel use, from the glimpse already obtained Barāqish might be a choice place to look for it. Zooarchaeological results from deeper levels in the city, reaching back to perhaps the 13th century BC, will thus be of considerable interest.

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Update April 2016

During the six years since this article was completed (December 2009) and accepted for publication (January 2010) a substantial amount of literature on subjects discussed in its final section has appeared: here is a highly selective account. A masterful treatment of dromedary domestication from an Arabian perspective, in the context of the Near and Middle East, has been presented by P. Magee: *The Archaeology of Prehistoric Arabia*, Cambridge University Press, 2014, 197–213 (ch. 7), 258–74; and 'When was the dromedary domesticated in the ancient Near East?', *Zeitschrift für Orient-Archäologie* 8 (2015), 252–77. Magee would argue for a preeminent role of southeastern Arabia in developing the dromedary for desert transport, possibly in emulation of Bactrian camel use across the Gulf, although acknowledging my hypothesis of such a role for southwestern Arabia. Equally comprehensive, from a predominantly 'Near Eastern' perspective, is M. Heide's 'The domestication of the camel. Biological, archaeological and inscriptional evidence from Mesopotamia, Egypt, Israel and Arabia, and literary evidence from the Hebrew Bible', *Ugarit-Forschungen* 42 (2010), 331–82; soon to be followed by a major book, *The Camel in the Biblical World* (which I was kindly allowed to read before publication). Two multidisciplinary collections include reports on ancient dromedaries in Arabia: E.-M. Knoll & P. Burger (eds), *Camels in Asia and North Africa: Interdisciplinary Perspectives and their Past and Present Significance*, Wien, Österreichische Akademie der Wissenschaften, 2012, with contributions by R. W. Bulliet, M. and H.-P. Uerpmann, D. M. Varisco, and the late W. Dostal; and M. Mashkour & M. Beech (eds), *Ancient Camelids in the Old World – Between Arabia and Europe*, *Anthropozoologica* 49/2 (2014), particularly with articles by C. Grigson and H. Monchot; my own contribution can be read in conjunction with 'The wall and talus at Barāqish, ancient Yathill (al-Jawf, Yemen): a Minaean stratigraphy', *Proceedings of the Seminar for Arabian Studies* 41 (2011), 101–20. On particular topics or areas, the most significant update concerns the mining districts of the southern Levant, Timna' and Faynān. Not only have the old camel finds been published (C. Grigson, 'Camels, copper and donkeys in the early Iron

Age of the southern Levant: Timna revisited', *Levant* 44/1 (2012), 82–100), but new research has led to a redating of dromedary utilization in the region to not earlier than ca. 930 BC (Iron Age II): Ben-Yosef et al., 'A new chronological framework for Iron Age copper production in Timna (Israel)', *Bulletin of the American Schools of Oriental Research* 366 (2012), 1–41; L. Sapir-Hen & E. Ben-Yosef, 'The introduction of domestic camels to the southern Levant: evidence from the Aravah Valley', *Tel Aviv* 40 (2013), 277–85 (see also 'The socioeconomic status of Iron Age metalworkers: animal economy in the "Slaves' Hill", Timna, Israel', *Antiquity* 88/341 (2014), 775–90). This pattern is repeated in Syria (C. Becker, 'Die Tierknochenfunde', in H. Kühne et al. (eds), *Berichte der Ausgrabung aus Tall Shēkh Hamad/Dūr-Katlimmu* 8, 61–131, Wiesbaden, Harrassowitz, 2008), apart from a report of 'domestic' dromedaries in Late Bronze II: C. Grigson, 'The fauna of Tell Nebi Mend (Syria) in the Bronze and Iron Age—a diachronic overview. Part 1', *Levant* 47/1 (2015), 5–29. As to Barāqish, the distribution and status of the dromedary finds obtained from the crucially important 13th–8th century BC levels in sounding A/S1 remain unknown. A return to the site proved impossible after 2007, both due to A. de Maigret's death (2011) and warfare in Yemen; in 2015 the Italian Mission base was razed to the ground.

21. The Iron Age site of Muweilah (Sharjah, UAE) and the problems of dromedary domestication

Margarethe Uerpmann and Hans-Peter Uerpmann

Muweilah is one of the few archaeological sites in southeast Arabia where animal remains are preserved in larger quantities. It is a small fortified town of the Iron Age II period situated in the outskirts of Sharjah City. Of some 34,000 identified animal bones almost half are from fish. Among the 16,500 bones of domesticates there are more than 700 bones of dromedaries. In terms of find numbers only sheep and goat are more frequent. According to bone weights dromedaries are second in importance after sheep. Cattle amount to one-third of the camel bones in terms of numbers and to only one-fifth in terms of weight. They are the only other domesticates of any importance for Muweilah's subsistence. Assuming that dromedaries were not only kept for meat, but also for labour and milk, they were probably the most important living resource for the inhabitants of the township.

There is no commonly accepted evidence for the occurrence of the domestic dromedary prior to the Iron Age II period. Thus, the observation on the economic importance of this animal at Muweilah raises interesting questions with regard to the origins of the domestic dromedary and its early history. The wild dromedary, well known from several Bronze Age and Neolithic sites in southeast Arabia, is also represented at Muweilah together with a number of other wild animals

Keywords Dromedary, domestication, UAE, Iron Age

Introduction

The archaeological site of Muweilah is situated in the eastern outskirts

of Sharjah (the Emirate of Sharjah), just a few kilometres south of the International Airport of the city. It was discovered during archaeological reconnaissance carried out by a French mission to the Emirate in the 1980s. Its archaeological importance was realised after the first test excavations made by Peter Magee in 1994 (Magee 1996). Continued excavations since that time have meanwhile uncovered large areas (Fig. 21.1) of a complex Iron Age (IA) settlement surrounded by a ditch and a wall, and with diverse buildings, mostly constructed of mud-brick with roofs probably made of organic materials. Some of the buildings seem to have had special functions which cannot be described here in any detail (Magee *et al.* 2002). Of particular importance for the topic of the present paper is the fact that the town was apparently founded early in the 1st millennium BC and destroyed by fire during the late 8th or early 7th century BC and that it was not inhabited again afterwards. It seems that the remains of the mudbrick walls, decaying after the destructive event, embedded the floor horizons of the former town. This cover preserved a multitude of archaeological finds and among them many animal bones – which is a most fortunate circumstance in a geographic area where the preservation of bones at archaeological sites is usually precarious to non-existent.

Muweilah faunal remains

Up to now some 200,000 bone fragments have been analysed with a total weight of more than 100kg. However, only 37,676 of these fragments with a total weight of 71.5kg could be identified to some extent. The low degree of identification – 17% by number and 59% by weight – is indicative of the fact that systematic sieving of excavated sediments yielded large amounts of small bone fragments. These were classified according to animal size, mainly based on cortical thickness, in order to control potential biases caused by the low degree of identification. The obtained size-classification of the unidentified fragments was then compared to the same classes of animal sizes as observed in the identified bones. Since the distribution of size classes in both assemblages is quite similar, one may assume that the identified portion of the bone finds from the site is representative for all of the studied bone finds. Table 21.1 gives an overview of the so far identified faunal remains from Muweilah. The role of the domestic dromedary is highlighted in the summary of Table 21.1.

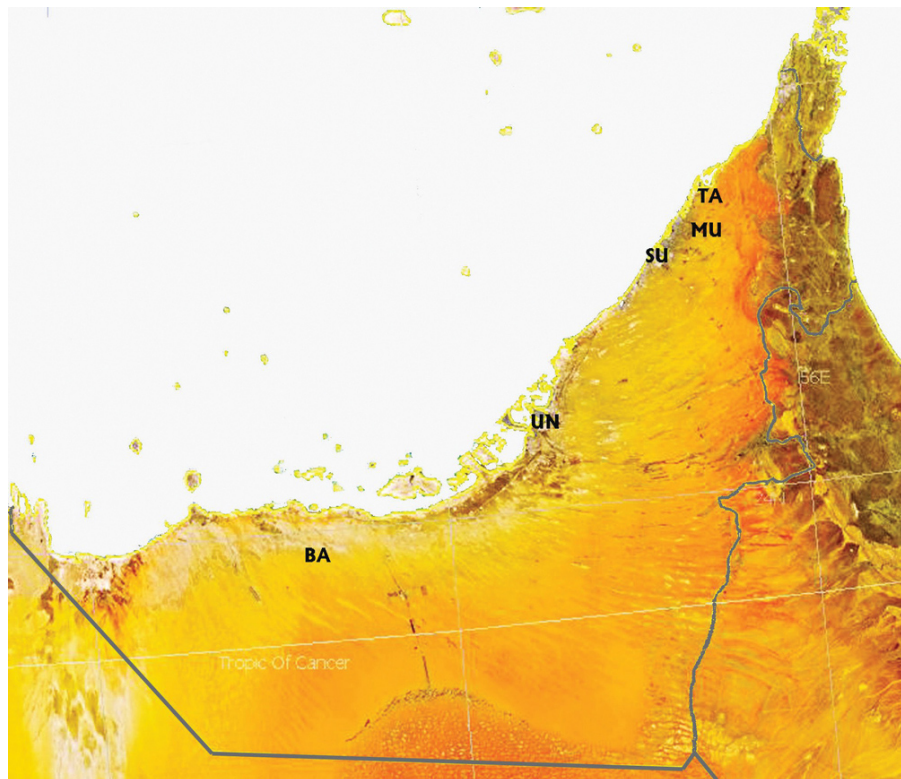


Fig. 21.1. Positions of the camel-sites mentioned in the text (TA=Tell Abraq, MU=Muweilah, SU=al-Sufou2, UN=Umm an-Nar, BA=Baynunah).

It is obvious from the bone weights in [Table 21.1](#) that the contribution of the dromedary to the meat consumed by the inhabitants of Muweilah was quite high. It was much more important than cattle, and when separating the contributions of sheep and goat according to the weightrelation of their identified bones, the camel was even more important than the goat. Only sheep contributed more meat to the subsistence economy of Muweilah than the dromedary. However, in order to assess the contribution of a particular species to human nutrition, milk as a potential life-time product has to be taken into consideration as well. The importance of the goat and perhaps also of cattle was probably much higher at Muweilah than indicated by boneweights. This cannot be discussed here in any detail for cattle, sheep and goat, because this would require detailed insight into the age-structures revealed by their bone-finds. Only the slaughtering ages of the Muweilah dromedaries can be considered in this respect. As indicated by [Figure 21.5](#) (below) they were probably exploited for milk as well. Thus, the importance of this animal for the subsistence

economy of Muweilah would probably not have changed much if – in addition to meat – milk as a lifetime-product is also taken into account. We may in any case conclude that the domestic dromedary had attained very high economic importance for the community living at Muweilah during the 1st quarter of the 1st millennium BC.

Table 21.1. Animal remains from Muweilah (as identified up to 2008)

<i>TAXA:</i>	<i>NIS*</i>	<i>NIS%</i>	<i>WIS**</i>	<i>WIS%</i>
Domestic cattle, <i>BOS</i>	239	1.32	2660.1	4.80
Domestic sheep, <i>OVIS</i>	1125	6.19	6153.7	11.09
Domestic goat, <i>CAPRA</i>	484	2.66	3062.4	5.52
Domestic sheep or goat (<i>OVIS/CAPRA</i>)	15,427	84.89	27,063.4	48.79
Domestic sheep and goat (<i>OVIS+CAPRA</i>)	17,036	93.74	36,279.5	65.41
Unidentified equid	2	0.01	37	0.07
Dromedary, <i>DROMEDARIUS</i>	891	4.90	16,473.3	29.70
Dog, <i>CANIS</i>	5	0.03	18.2	0.03
<i>Domestic animals: total</i>	<i>18,173</i>	<i>100.00</i>	<i>55,468.1</i>	<i>100.00</i>
Small whales or dolphins, CETACAE	3	0.46	7.8	0.15
Hare, <i>Lepus</i> sp.	58	8.94	39.2	0.77
Wolf, <i>Canis lupus</i>	7	1.08	85.9	1.70
Red fox, <i>Vulpes vulpes</i>	17	2.62	18.4	0.36
Rüppell's fox, <i>Vulpes rueppelli</i>	2	0.31	4.8	0.09
Striped Hyaena, <i>Hyaena</i> <i>hyaena</i>	4	0.62	16.1	0.32
Wild cat, <i>Felis silvestris</i>	8	1.23	9.2	0.18
Caracal, <i>Lynx caracal</i>	1	0.15	0.8	0.02
Leopard, <i>Panthera pardus</i>	1	0.15	8.8	0.17
Carnivora indet., small	2	0.31	2.8	0.06
Carnivora indet., medium sized	2	0.31	3.2	0.06
Carnivora indet., large	1	0.15	3.3	0.07
Seacow, <i>Dugong dugon</i>	1	0.15	25	0.49
Wild dromedary, <i>Camelus</i> spec.	9	1.39	406.5	8.03
White Oryx, <i>Oryx leucoryx</i>	316	48.69	3508.2	69.28
Sand gazelle, <i>Gazella subgut.</i> <i>marica</i>	4	0.62	23.7	0.47
Gazelle, <i>Gazella</i> spec.	213	32.82	900	17.77
<i>Wild mammals: total</i>	<i>649</i>	<i>100.00</i>	<i>5063.7</i>	<i>100.00</i>
Cormorant, <i>Phalacrocorax</i> <i>nigrogularis</i>	662	89.22	806.6	90.29
unidentified birds	80	10.78	86.7	9.71
<i>Wild birds - Total</i>	<i>742</i>	<i>100.00</i>	<i>893.3</i>	<i>100.00</i>
unident. sea turtles, Chelonidae indet.	12	50.00	58.4	94.19
other unident. reptiles	12	50.00	3.6	5.81
<i>Reptiles - Total</i>	<i>24</i>	<i>100.00</i>	<i>62</i>	<i>100.00</i>
Sharks, CARCHARHINIDAE	23	0.13	15.3	0.15
Hammerhead sharks, SPHYRNIDAE	10	0.06	3.5	0.03
Sawfishes, PRISTIDAE	8	0.04	10.4	0.10
Guitarfishes, RHINOBATIDAE	114	0.63	17.9	0.18
Giant guitarfishes, RHYNCHOBATIDAE	32	0.18	26.9	0.27
Eaglerays, MYLIOBATIDIDAE	7	0.04	1.3	0.01
Unidentifiable CHONDRICHTHYES	106	0.59	29.5	0.29
Herrings, CLUPEIDAE	2	0.01	1.1	0.01
Sea catfishes, ARIIDAE	17	0.09	11.1	0.11
Needlefishes, BELONIDAE	43	0.24	9.5	0.09
Flatheads, PLATYCEPHALIDAE	4	0.02	1.1	0.01
Groupers, SERRANIDAE	663	3.67	1358.9	13.55
Remoras, ECHENEIDIDAE	3	0.02	1	0.01
Jacks, CARANGIDAE	357	1.97	482.6	4.81
Snappers, LUTJANIDAE	5	0.03	1.1	0.01
Grunts, HAEMULIDAE/ POMADASIDAE	9	0.05	6	0.06
Emperors, LETHRINIDAE	120	0.66	65.1	0.65
Seabreams, SPARIDAE	3405	18.82	1747.7	17.42
Butterflyfishes, CHAETODONTIDAE	1	0.01	1	0.01
Mullets, MUGILIDAE	456	2.52	142.7	1.42
Baracudas, SPHYRAENIDAE	77	0.43	40.3	0.40

Parrotfishes, SCARIDAE	32	0.18	7.5	0.07
Rabbitfishes, SIGANIDAE	4	0.02	0.5	0.00
Tunas, Mackerels, SCOMBRIDAE	880	4.87	880.2	8.78
Unidentifiable OSTEICHTHYES	11,710	64.74	5167.8	51.52
<i>Fish: total</i>	<i>18,088</i>	<i>100.00</i>	<i>10,030.0</i>	<i>100.00</i>

identified animal remains	37,676	16.72	71,517.1	59.02
unidentified animal remains	187,675	83.28	49,654.9	40.98
<i>Animal remains: total</i>	<i>225,351</i>	<i>100.00</i>	<i>121,172.0</i>	<i>100.00</i>

Summary totals

Domestic animals	18,173	48.23	55,468.1	77.56
Wild mammals	649	1.72	5063.7	7.08
Wild birds	742	1.97	893.3	1.25
Reptiles	24	0.06	62	0.09
Fish	18,088	48.01	10,030.0	14.02
Identified Animal Remains	37,676	100.00	71,517.1	100.00
<i>Dromedary,</i> <i>DROMEDARIUS</i>	<i>891</i>	<i>2.36</i>	<i>16,473.3</i>	<i>23.03</i>

* NIS = Number of identified bone specimens;

** WIS = Weight of identified bone specimens

Not far from Muweilah, ca. 25km to the southwest and now in the centre of the city of Dubai, there is another new site where camel remains form the bulk of the excavated faunal remains: the so-called camel butchering site of Al-Sufouh 2 yielded many more camel bones than Muweilah. These bone finds are from a context of the Middle and Late Bronze Age (MBA/LBA) Wadi-Suq-Culture representing the time period from around 1700–1200 BC. Thus, the finds are around 500 years older than those from Muweilah. They are considered to be from wild camels (von den Driesch & Obermeier 2007), and there is indeed nothing to indicate the presence of domestic dromedaries at al Sufouh 2. The same is true for the Early Bronze Age (EBA) site of Umm an-Nar, where camel bones are also an important constituent of the faunal remains excavated from this settlement dating to the middle of the 3rd millennium BC and situated near Abu Dhabi some 120km farther southwest along the coast of the Gulf (Uerpmann & Uerpmann 2008). Another new sample of the early Holocene period from Baynunah in the Western Region of the Emirate of Abu Dhabi was recently evaluated by Beech *et al.* (2009 and this volume) and adds new data for the Holocene wild dromedary population in SE-Arabia.

Up to now, assumptions about early dromedary domestication in this general area rested mainly upon the faunal remains from Tell Abraq – one of the few stratified sites of the late prehistoric periods in southeast Arabia (Fig. 21.2). It is situated only about 25km north of Muweilah. Its stratigraphy begins with layers of the late Umm an-Nar culture (EBA), superimposed by four strata of the Wadi Suq culture (MBA and LBA) and three Iron Age layers. The general development of animal economy at Tell Abraq was described by M. Uerpmann (2001).

Wild dromedaries were the major terrestrial animals hunted by the inhabitants of Tell Abraq during all phases of the Bronze Age, leading to a marked decrease in their numbers among the faunal remains of the successive layers from the Umm an-Nar period (EBA) and into the beginning of the IA, when camel remains disappeared completely from the assemblage. Camel bones re-appear at Tell Abraq in the assemblage of the Iron Age II, the phase to which Muweilah also belongs. They are absent again in the uppermost layer of the Iron Age (IA III) and in the ed-Dur phase, but the faunal assemblages from these contexts are too small to be conclusive in regard to the non-occurrence of rare faunal elements. As described in detail by the present authors (Uerpmann & Uerpmann 2002), there is convincing evidence that most of the camel remains from the Iron Age II at Tell Abraq are from domestic dromedaries, while all the older finds are from wild animals.

The identification of the IA II camels from Tell Abraq as domestic dromedaries was based on a marked size difference between the camel bones from the Bronze and the Iron Age levels. While we still consider this evidence as convincing, there is an ongoing debate among archaeozoologists whether size differences should at all be used in attempts to identify early domestication. It would go too far to enter into all details in this discussion, but it should be made clear that there is a fundamental difference between identifying domestic animals and identifying the process of domestication. A domestic animal is – by definition – different from its wild ancestor; with size being one of the few characteristics of both wild and domestic animals which can objectively be measured in skeletal remains and then compared between the different bone assemblages. If there are differences between two populations and if there are archaeological indications that a wild versus a domestic status might be responsible for these differences, it is legitimate to consider them as evidence for the genetic separation between wild and domestic members of the respective species which is the result of the domestication process. One could also think about archaeological traces of this process itself,

which might be visible in an archaeological context. However, in the desert areas of Arabia, the conditions of archaeological preservation are too poor to hope for such direct traces of human–animal interaction. Through diachronic approach it is in any case possible to identify the wild ancestors on the one side and their altered domestic offspring on the other, as soon as the observable characteristics are recognizably different. This implies that the animals under human control continue to breed in well maintained genetic isolation from their wild relatives. The time required for the process of differentiation does not matter in terms of its final result, which is the co-existence of two populations of the same species, one of them living wild and the other under human control.

With regard to changes in body size as potential indicators of domestication, this means that these changes in body size must have been restricted to the domestic population, while the wild population remained unchanged at the same time. As clearly shown in recent research on isolated animal populations, body size is a highly sensitive indicator for life circumstances and their temporal changes (Ozgul *et al.* 2009). Many reasons for a diminution of body size in early domestication have already been discussed (e.g. Uerpmann 2008). Depending on the particular circumstances, all of them may have contributed to the observed size changes in early domesticates. It is of course necessary to make sure that size changes within such a population are ‘real’ in a statistical sense, and not – for instance – only caused by a numerical increase of smaller animals (e.g. females) within the measured sample. The new complexes of camel remains from Baynunah and al-Sufouh 2 provide an opportunity to verify earlier observations on the size of wild dromedaries in southeast Arabia and also to examine changes in population structures as indicators of particular forms of exploitation of the respective populations.

Figure 21.3 represents the distribution of LSI values for camel remains of all collections from southeast Arabia presently available to the authors. LSI calculations are based on the same standard individual (skeleton CA4 in the Tübingen collection) as used in earlier publications (e.g. Uerpmann & Uerpmann 2002). The graphs clearly demonstrate that size variability is quite large at al-Sufouh 2 with regard to both maxima and minima¹ of the total size range. This is probably a function of the large sample size. The occasional occurrence of very large or very small animals in a wild population usually remains hidden in smaller samples.

The statistical indicators of variability – inter-quartiles² and

standard deviation³ – are not wider in the al-Sufouh 2 sample than in the much smaller sample of Bronze Age camel remains from Tell Abraq. At Umm an-Nar there is an apparent lack of very large animal remains, which reduces the statistical variability of the camel finds from this island site. Nevertheless, the mean values are identical to those of the al-Sufouh 2 sample. The small measurable sample from the Bronze Age (BA) layers of Tell Abraq on the other hand is apparently poor in remains of female species, which increases the mean values of the respective LSI graph. The sample from Baynunah, directly transferred from figure 9 in Beech *et al.* (2009, 26), is interesting insofar as smaller animals dominate. This indicates that important differences might exist between anthropogenic and natural accumulations of camel remains. The Baynunah finds most probably represent a natural death assemblage of Early Holocene wild dromedaries in a low lying desert area where water accumulated in temporary pools – sometimes leaving animals to die of thirst if there was no rain to refill the ponds. This would have affected all members of a wild herd, perhaps with a slight advantage for large and strong individuals which might have been able to get away from the area before it was too late. In general, however, the size-structure of the accumulation is likely to represent the living population – probably more so than assemblages accumulated by human hunters. Hunting might to some extent distort size-distributions, particularly in large and well-defended animals, where males tend to be less fugitive than females. Males may therefore be more or less overrepresented in assemblages accumulated by hunters. Nonetheless, the mean LSI of the camel bones from Baynunah is not much below that observed at Umm an-Nar and al-Sufouh 2 (Fig. 21.3). A very large male found at Baynunah corroborates the maximal LSI values for al-Sufouh 2.

TELL ABRAQ (UAE) Domestic Ruminants versus Dromedary

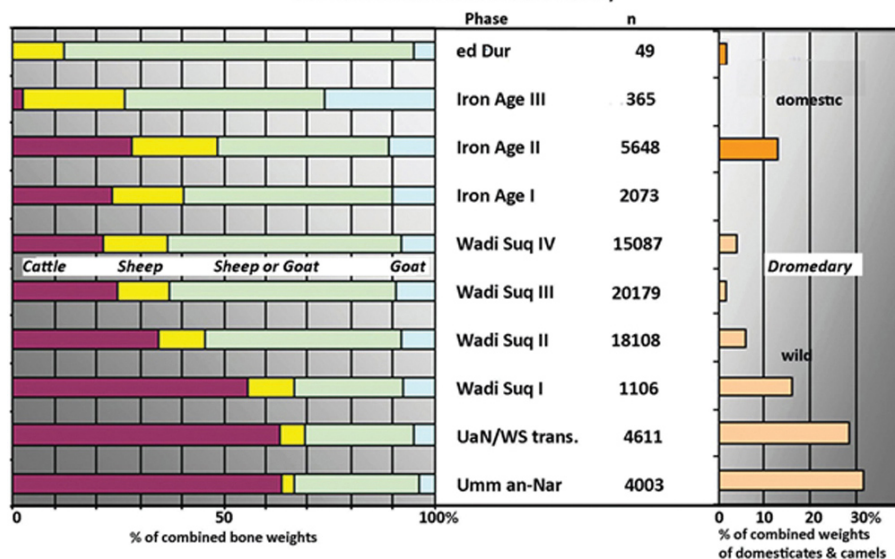


Fig. 21.2. Frequencies of domestic ruminants and camels in the stratigraphy of Tell Abraq (from Uerpmann 2001).

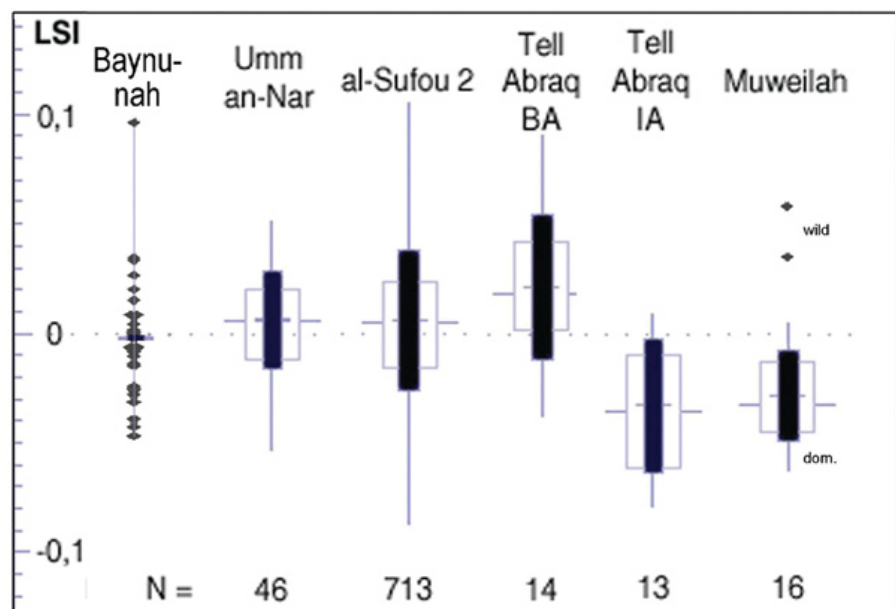


Fig. 21.3. LSI distributions of dromedary finds from sites in southeast Arabia.

At Muweilah two finds of clearly wild camels were recorded. As far as represented by the few measurable bones, the domestic

dromedaries from Muweilah are similar in size to the Iron Age dromedaries of Tell Abraq. Unfortunately the number of measurable finds is quite low at Muweilah due to the bad state of preservation of the bones. On the whole, the finds from Muweilah corroborate the earlier observations on a shift in the average sizes of dromedaries in southeast Arabia at the onset of the Iron Age, which most probably indicates domestication of this species around this time. Contrary to Tell Abraq, the domestic dromedary acquired real economic importance at Muweilah during the Iron Age II as indicated by the quantity of its bone remains in relation to the rest of the fauna.

The presence of domestic dromedaries at Muweilah is also indicated by several finds of statuettes, which represent one-humped camels with a load or a saddle on their hump (Fig. 21.4). Such statuettes are clear archaeological evidence for the existence of domestic dromedaries during the Iron Age II in the area. These finds from Muweilah are a cultural expression of the importance of this animal for the inhabitants of this settlement.



Fig. 21.4. Dromedary statuette from Muweilah (photo: P. Magee).

As a third line of evidence the amount of camel finds from Muweilah provides the opportunity to evaluate the kill-off patterns of dromedaries at this site. Kill-off patterns indicate how people exploited a particular animal species. Hunting them at random should produce another kill-off pattern than breeding and managing them for particular purposes. As tooth-bearing jaws of camels preserve badly – even worse than postcranial bones – kill-off patterns for the dromedaries of Muweilah had to be reconstructed from the evaluation of epiphyseal fusion. Although the exact timing of epiphyseal fusion in camels is badly known, estimates can be based on skeletal material in comparative collections and on the respective data for other artiodactyls. For the graphs in Figure 21.5 we have grouped epiphyses into an early, middle and late state of fusion, with the respective

epiphyses fusing at roughly 12, 30 and 48 months. The early stage (≈ 12 months) includes the distal epiphysis of the humerus and the proximal epiphyses of radius and first and second phalanges.

For the middle stage (≈ 30 months) we used the distal tibia and for the late stage (≈ 48 months) we used the proximal epiphyses of humerus, ulna, femur and tibia and the distal epiphyses of radius and femur as well as the apophyses of vertebra. In addition to the counts of fused versus unfused epiphyses, the occurrence of some 15% of infantile bones at Muweilah was used as indication for slaughtering of young animals less than about 6 months old. Although the results represented in Figure 21.5 are liable to alteration once more detailed information on epiphyseal fusion in dromedaries becomes available in the future, the relative differences observed in comparison to the camel remains from al-Sufouh 2 will remain valid.

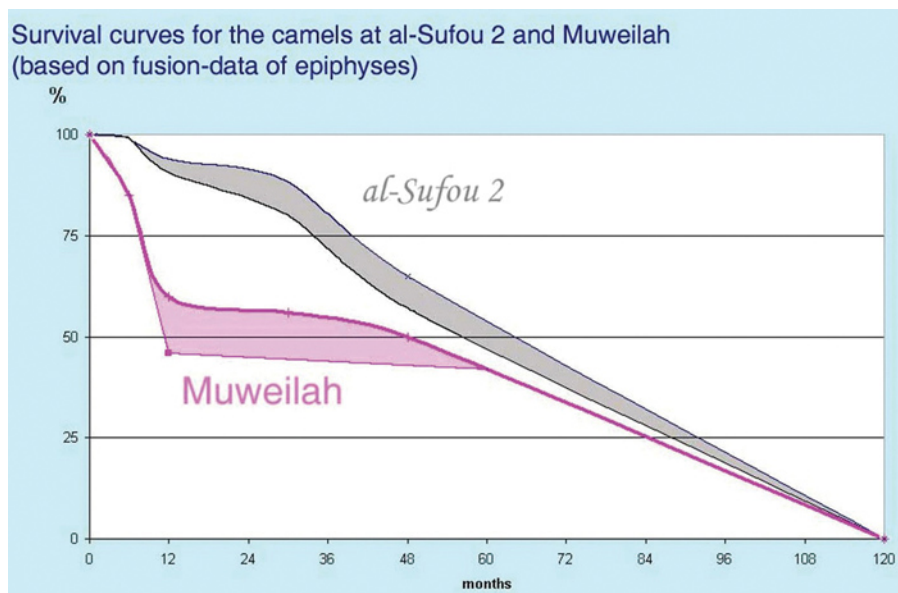


Fig. 21.5. Survival rates of dromedaries at Muweilah and al-Sufou2 based on epiphyseal fusion.

The counts for the early stage of epiphyseal fusion (12 months) for Muweilah vary between the different skeletal elements. This is reflected by a range of insecurities as indicated in Figure 21.5 by the pink area below the most probable survival curve for the Muweilah dromedaries. The kill-off pattern of dromedaries at al-Sufouh 2 as documented by von den Driesch and Obermaier (2007) is marked in grey with its respective range of insecurity. The differences between

the two sites are obvious: At Sufouh 2 less than 10% of the animals were killed at an age under 12 months, while at Muweilah more than one-third of the animals did not survive this age. After this kill-off of juveniles, the survival curve for Muweilah flattens, probably indicating the exploitation of life-time products – labour and possibly milk – of the adults reaching ages of 4 years and beyond. It is obvious that the pattern of dromedary exploitation changed differed from al-Sufouh 2, where a wild dromedary population was extensively hunted, to Muweilah, where domestic dromedaries were utilised for their respective products together with domestic sheep, goats and cattle.

The clear differences – both in body -size and in the pattern of exploitation – between the Iron Age and the Bronze Age and older dromedaries in the area, which is now the UAE, indicates that either the domestication of this species happened locally in the badly known transitional phase from the Late Bronze to the Early Iron Age or that the domestic dromedary was introduced to the area from an hitherto unknown centre of camel domestication outside southeast Arabia. More evidence will probably come to light when other important archaeological sites in the United Arab Emirates and Oman will have been evaluated with regard to their animal remains. Large areas of the Arabian Peninsula, where the wild dromedary presumably occurred during the Early Holocene and where its domestication must have happened, are also completely unexplored in respect to their archaeozoology. An exception are sites in the Yemen, where thanks to the work of Francesco Fedele (2009 and this volume) we know about the presence of the domestic dromedary in the Sabaeen town of Yalā at roughly the same time as the Iron Age II in the Emirates.

The introduction of the domestic dromedary into an area, where its wild ancestor did *not* exist beforehand, was recently published by Cornelia Becker for Tell Sheikh-Hamad on the Khabur River in northeast Syria (Becker 2008). Remains of dromedaries were discovered at Sheikh Hamad in layers of the Neoassyrian Phase, the beginnings of which correspond to the Iron Age in southeast Arabia. The domestic dromedary was already well known from the palace reliefs of this period in Mesopotamia. Textual evidence reports its contemporaneous presence in the Levant. It will be interesting to critically review the dating evidence for the appearance of this animal in the coastal areas of the Eastern Mediterranean, which also were outside the natural range of the wild dromedary.

Even more interesting than the dromedary finds from Tell Sheikh Hamad are the other findings of Cornelia Becker at this important place: There are remains of the two-humped or Bactrian camel at this

stratified site from layers below those which yielded the dromedary finds. As the wild ancestor of the Bactrian camel is not known to have occurred in the Djazirah area of Syria or in Lower Mesopotamia, the respective finds also indicate an early introduction: In this case, of the domestic twohumped camel from its hitherto unknown area of original domestication. This area may well have been the dry steppes and deserts of the Iranian Highland, where the wild two-humped camel may have existed (Uerpmann 1987) and where it may have been domesticated during the Bronze Age – as possibly indicated by the early findings at Shar-e-Sokhta (Compagnoni & Tosi 1977). If domestic Bactrian camels existed in South-eastern Iran at the end of the 2nd millennium BC, dromedary domestication in Arabia might have been inspired by contacts across the Gulf. Such contacts are well documented by finds from Muweilah (Magee 1999; 2002). It should, however, also be mentioned that the site also yielded evidence for contacts with South Arabia in the form of an inscribed name on a large jar using the Old South Arabic alphabet (Magee 1999). Thus, Muweilah is on the crossroads of the early history of dromedary domestication not only with regard to its animal remains. However, in spite of the early occurrence of domestic dromedaries at sites in the UAE this does not necessarily indicate that this area was the geographic place of origin for this important domestic animal. Only a major intensification of archaeozoological research throughout the Arabian Peninsula will provide a solid answer to the most interesting question where dromedaries were tamed and domesticated for the first time.

Notes

- 1 Indicated by the 'whiskers' of the graphs for each site.
- 2 Indicated by the open boxes in the graphs.
- 3 Indicated by the black bars in the graphs.

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22. Fish exploitation at Qal'at al-Bahrain from the Early Dilmun period (3rd millennium BC) to the Middle Islamic period (13th–16th centuries AD): preliminary results

Justine Vorenger

Excavations have taken place at the site of Qal'at al-Bahrain in Bahrain since the 1950s. The site, located in the Persian Gulf, has been excavated by the French Archaeological Mission since 1977. Excavations have revealed significant architectural remains as well as a rich assortment of material, including ceramics, metal objects, botanical and faunal remains, which include a large number of fish bones. Exceptional stratigraphy, that extends from the Early Dilmun (3rd millennium BC) to the Middle Islamic period (13th–16th centuries AD), provides the possibility for studying successive occupations at the site.

The preliminary results discussed here are based on the analysis of fish bones from the French excavations. A total of 5763 fish bones have been studied, out of which 2552 can be quantified which have precise stratigraphic dating. Five families dominate the assemblage during the occupation at the site: groupers (Serranidae), jacks/trevallies (Carangidae), seabream (Sparidae), emperors (Lethrinidae) and tuna/mackerel (Scombridae). The taxonomic variety increases however to a total of 11 families during the Islamic period. The preliminary results discussed here provides evidence of the focus on marine exploitation, in comparison to the consumption of mammals (cf. the previous study carried out by Carine Tomé).

Keywords Bahrain, archaeo-ichthyology, fishing, fishes, Dilmun

period, Tylos period, Islamic period, palaeo-economy

Introduction

Fishing in the Persian Gulf has played an important role in the economy of local populations since the earliest times. Since more than 20 years there have been a number of studies and syntheses of this material (Beech 2004). The site of Qal'at al-Bahrain, located in the island of Bahrain, occupies a key position (Fig. 22.1).

Excavations at the settlement of Qal'at al-Bahrain began in 1954, and have revealed a remarkable stratigraphy and chronology. Favourable environmental and geographic conditions led to the development of an Early Dilmun settlement (ca. 2200–1750 BC) which continued until the Islamic period (15th century AD). This includes a number of significant buildings, performing military (the fort), political and religious (the palace) and civilian (the houses) functions, epitomising the economic expansion of the ancient Dilmun capital (Figs 22.2 & 22.3).

The fauna from the site has already been subject to a number of studies. Material from the Danish excavations at Qal'at al-Bahrain has been studied by Uerpmann (1993) and Uerpmann and Uerpmann (1994; 1997). They determined that the majority of the remains consisted of not only groupers (Serranidae), jacks/trevallies (Carangidae), emperors (Lethrinidae) and seabream (Sparidae), but also of cartilaginous fishes, i.e. sharks and rays. For the Middle and Late Dilmun periods, Van Neer and Uerpmann (1994) also remarked upon the presence of sharks and rays, and of bony fishes from at least a dozen families, principally groupers, jacks/trevallies, emperors and seabream. The material collected from the first excavation campaigns of the French Archaeological Mission were studied by Desse-Berset (1995). Her results complement those obtained previously, however they were qualitative in nature and did not provide precise quantifications. Nineteen families were determined belonging to both bony and cartilaginous fishes (Table 22.1). The same four families dominated the assemblage, to which could be added rabbitfish (Siganidae), needlefish (Belonidae), sardines/herrings (Clupeidae), grunts (Haemulidae), parrotfish (Scaridae), mullets (Mullidae), snappers (Lutjanidae) and tuna/ mackerel (Scombridae).



Fig. 22.1. Location of Qal'at al-Bahrain and other key sites in Bahrain (source: French Archaeological Mission, drawn by H. David)

With respect to other taxa present at the site, one should mention the previous study of the mammalian faunal remains from the site

(Tomé 2003). This study remarked upon the predominance of sheep/goat (7667 elements out of 9100 determined bone fragments). From the Early Dilmun to Tylos periods the fauna was dominated by domestic species, representing 90.7% of all animals consumed (Fig. 22.4). Additional species noted there included cattle, dog, pig, equid, camel, chicken, cormorant, sea turtle, dugong, gazelle, hare, cat, mongoose, pink flamingo and grey heron.



Fig. 22.2. Aerial view of Qal'at al-Bahrain (source: French Archaeological Mission in Bahrain)



Fig. 22.3. View of the excavations at Qal'at al-Bahrain (source: J.

The consumption of shellfish is also attested by the discovery of numerous fragments (Cataliotti-Valdina, 1994). An interesting variety of shells have been identified including *Turbo* sp., *Strombus* sp., *Conus* sp., *Marcia* sp., *Cypraea* sp., and of course, pearl oyster, *Pinctada* sp. Shellfish were exploited for food, however after their consumption, shells were used as raw material for the manufacture of artefacts.

Some additional environmental studies have also been carried out at the site, such as the analysis of archaeobotanical remains from the Dilmun and Tylos period levels (Tengberg & Lombard 2002). Three types of remains were recognised, wood charcoal, carbonised seeds and plant impressions in mud-brick fragments. Some species noted are indigenous, whilst others result from imported items. It is important to note the presence of date palm (*Phoenix dactylifera*), jujube (*Zizyphus spinachristi*), barley (*Hordeum vulgare*) and wheat (*Triticum durum/aestivum*).

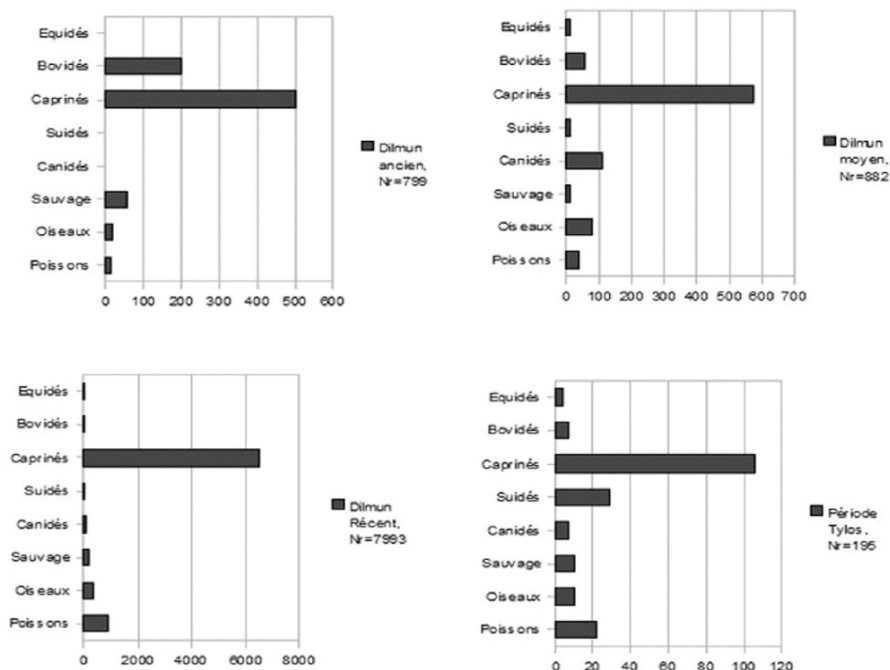


Fig. 22.4. Evaluation of different types of animal taxa by occupation period from the central excavation area at Qal'at al-Bahrain (after Tomé 2003)

The approach taken here aims to give a diachronic view of the occupation of Bahrain from the Early Dilmun to Islamic periods. Here,

we present preliminary results on the fish species identified and the habitats from which they originate, as compared with previously published faunal studies.

Qal'at al-Bahrain

Located in the Persian Gulf, on Bahrain Island, Qal'at al-Bahrain was a large harbour placed in a strategic geographic location, in the middle of the Gulf between Europe and Asia (Fig. 22.1). It has been a significant commercial and maritime location for several millennia. This tell or occupation mound, situated facing the sea, has provided archaeologists with an exceptionally deep stratigraphic sequence of deposits, unique within the Arabian peninsula. Beyond its clear regional status, Qal'at al-Bahrain represents a true testament to the historical and economic development of Dilmun, one of the most important cultures of the ancient Gulf. Moreover, Qal'at al-Bahrain was the capital of ancient Dilmun from the 3rd millennium BC to the 18th century AD.

The site is exceptional because of its coastal position and the presence of artesian springs that enabled the development of date palm gardens (Sanlaville, 1988), so that it was certified by the Sumerians as 'paradise on earth'. Its coastal location led to it playing a key role in trade relations with Mesopotamia, the Iranian and Arab coasts, with Oman, the Indian subcontinent or the Far East, as can be demonstrated by various import items found in archaeological contexts at the site (Lombard, 1999).

Excavations at the site began in 1954 under the direction of a Danish team led by Geoffrey Bibby and Peter Vilhelm Glob. Twenty-four years of excavation permitted the identification of successive occupations and an initial chronology. In 1978, Monik Kervran founded the French Archaeological Mission to Bahrain to continue the previous work. Her research focused on fortified buildings from the Islamic era and then investigated the coastal fortress and the 'Portuguese Fort'. In 1989, Pierre Lombard took over and turned more towards the earlier periods. He concentrated excavations on the southeast side of the Portuguese fort, and its interesting building complex, known as the 'Ouperi Palace', dating from the early Dilmun (ca. 2300–1800 BC.), Middle Dilmun (mid-2nd millennium BC.) to Late Dilmun period (first half of the 1st millennium BC). This work refined the chronological development of the site proposed by the Danish team. After the abandonment of the palace, the construction of Tylos period (ca. 300 BC–AD 300) domestic structures, also provided

rich material. Finally, the excavation campaigns led to the discovery of the first levels of the Islamic town (13th–16th centuries AD).

Table 22.1. Comparison of fish taxa from the different archaeological missions at Qal'at al-Bahrain.

FAMILY	SPECIES	COMMON NAME	Danish excavations 1954–1978 (Van Neer & Uerpmann 1994)		French excavations 1989–1994 (Desse- Berset 1994; 1995)		French excavations 1989–2004 (Vorenger, this study)
Carcharhinidae		Shark					
Sphyrnidae		Hammerhead Shark					
Pristidae		Sawfish					
Rhinobatidae		Guitarfish					
Clupeidae	<i>Sardinella</i> sp.	Sardine					
Ariidae	<i>Netuma</i> spp.	Sea Catfish					
Belonidae	<i>Ablennes hians</i>	Needlefish					
Belonidae	<i>Tylosurus</i> spp.	Needlefish					
Triglidae	<i>Lepidotrigla</i> sp.	Gurnard					
Platycephalidae	<i>Platycephalus indicus</i>	Indian Flathead					
Serranidae	<i>Epinephelus</i> spp.	Grouper					
Echeneidae	<i>Echeneis naucrates</i>	Remora					
Carangidae	<i>Alectis indicus</i>	Threadfish					
Carangidae	<i>Alepes</i> mate	Scad					
Carangidae	<i>Atule</i> mate	Yellowtail scad					
Carangidae	<i>Carangoides bajad</i>	Orange Spotted Jack					
Carangidae	<i>Carangoides</i> <i>chrysophrys</i>	Longnose Trevally					
Carangidae	<i>Gnathanodon speciosus</i>	Golden Trevally					
Carangidae	<i>Scomberoides</i> <i>commersonianus</i>	Talang Queenfish					
Carangidae	<i>Seriola dumerili</i>	Greater Amberjack					
Carangidae	<i>Seriola</i> spp.	Amberjack					
Carangidae	<i>Trachinotus</i> spp.	Pompano					
Lutjanidae	<i>Lutjanus</i> sp.	Snapper					
Haemulidae	<i>Diagramma pictum</i>	Painted Sweetlips					
Haemulidae	<i>Plectorhinchus</i> <i>sordidus</i>	Sordid Thicklip					
Haemulidae	<i>Plectorhinchus</i> spp.	Sweetlips					
Haemulidae	<i>Pomadasys stridens</i>	Striped Grunt					
Lethrinidae	<i>Lethrinus</i> sp.	Emperor					
Sparidae	<i>Acanthopagrus</i> <i>bifasciatus</i>	Double-barred Seabream					
Sparidae	<i>Acanthopagrus berda</i>	Twobar Seabream					
Sparidae	<i>Argyrops spinifer</i>	King Soldierbream					
Sparidae	<i>Diplodus sargus</i>	Onespot Porgy					
Sparidae	<i>Rhabdosargus</i> spp.	Goldstriped/Haffara Seabream					
Sparidae	<i>Sparidentex hasta</i>	Sabaity					
Mugilidae	<i>Valamugil</i> sp.	Mullet					
Mullidae	<i>Parupeneus</i> sp.	Goatfish					
Scaridae	<i>Scarus</i> sp.	Parrotfish					
Sphyraenidae	<i>Sphyraena</i> spp.	Barracuda					
Scombridae	<i>Scomberomorus</i> <i>commerson</i>	Narrow-barred Spanish Mackerel					
Scombridae	<i>Scomberomorus</i> spp.	Mackerel					
Scombridae	<i>Euthynnus affinis</i>	Kawakawa/ Little Eastern Tuna					
Scombridae	<i>Thunnus</i> spp.	Tuna					
Siganidae	<i>Siganus</i> spp.	Rabbitfish					

Excavation campaigns conducted since 1954 have thus enabled the uncovering of various architectural components, both administrative (the palace), military (fortresses), or domestic, but also a lot of materials (ceramics, metals, vegetation, wildlife) that inform us about the lifestyles of island populations successive Bahrain (Højlund & Andersen 1997).

The majority of the occupation levels at the site have been investigated and their study provides precise chronological information. Thus, the Early Dilmun period city is succeeded by a phase of public buildings during the Middle Dilmun and Late Dilmun periods (characterised by pre-Achaemenid and Achaemenid

occupation). During the Tylos period, the city is influenced by the Seleucid-Parthians, which precedes the establishment of an Islamic city. The rulers of Hormuz construct at the site a vast fortress in the fourteenth and fifteenth century. In the 16th century, the Portuguese, by reinforcing the corner bastions, give it the name 'the Fort of Bahrain' – Qal'at al-Bahrain (Lombard & Kervran 1989).

Archaeological contexts and retrieval methods

THE SAMPLE

The bone material collected during the campaigns led by Pierre Lombard since 1989 is abundant. The bones are currently being studied from various excavations conducted from 1989–1996, and 2000–2004. All periods of occupation of the site are represented in the material. Thus, the large building complex, called the 'Ouperi Palace' provided a substantial amount of material. The Late Dilmun period comprised the majority of the material (4054 out of the 5763 bone remains studied). The domestic occupation material from the Tylos period and the Islamic era complete the remainder of the sample (Table 22.2). Only a total of 2552 can, however, be so far quantified which have precise stratigraphic dating. Smaller quantities of bones are noted for the Tylos period (NR = 160) and Early Dilmun period (NR = 237), since the full extent of the occupation horizons for these particular periods were not uncovered during the excavation.

RETRIEVAL METHODS

The bones were mostly collected in the field by manual retrieval. Their relative abundance and good preservation conditions have facilitated their collection. However, systematic screening of part of the sediment was carried out for all Dilmun period levels. In the case of later deposits, such as the Tylos and Islamic period periods, sieving was only carried out for some stratigraphic units. These samples provide smaller fish anatomical elements that are not necessarily found by hand retrieval, such as otoliths and scales. In addition, the sieved samples help reveal the presence of bones from smaller species like sardines and herrings (Clupeidae). In general, the material was collected from within particular structures and by stratigraphic unit, which allows its designation to particular occupation periods.

CONSERVATION

The excellent preservation of the material facilitates the identification of many of the bones and their abundance provides a broad spectrum of taxa for all periods. However, some material, mostly dating from

the Middle Dilmun period, was extremely fragmented making its identification problematic. On the majority of the remains, cut marks, where available, could be clearly witnessed ([Fig. 22.5](#)). Finally, the generally good state of conservation of material provides a remarkable anatomical diversity (vertebrae, skull bones, otoliths, scales).

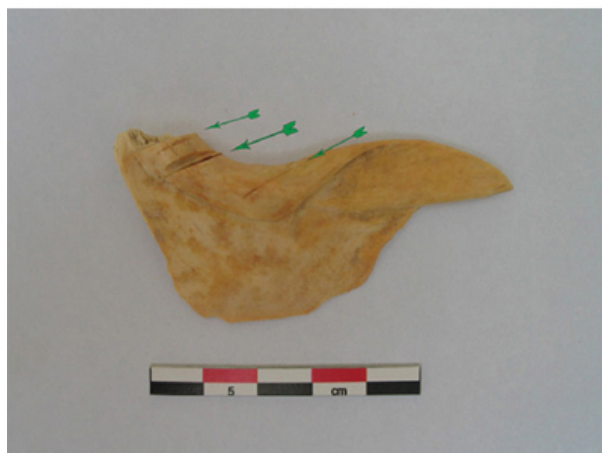


Fig. 22.5. Butchered and burnt fish bones from Qal'at al-Bahrain: a. Burnt Grouper (*Epinephelus* spp.) premaxillar, right side (Early Dilmun period, US 1898); b. Grouper (*Epinephelus* spp.) cleithrum, left side, with traces of cut marks, US 2113); c. Golden Trevally (*Gnathanodon speciosus*) premaxillar, left side, with chop mark (Late Dilmun period, US 695)



Fig. 22.6. Different fishing methods utilised in Bahrain: a. 'Haddrah', traditional tidal fish traps located near to Qal'at al-Bahrain (Source: National Museum of Bahrain); b. fishing boat loaded with 'gargoor' basket traps; c. a fisherman using a net in shallow coastal waters; d. examples of stone net sinkers in the National Museum of Bahrain

The list of taxa identified must be viewed with caution because of the absence of systematic sieving for each occupation level (less sieving was carried out from the Tylos and Islamic period levels), thus giving an incorrect view of the fish consumed at the site. Indeed, the high biodiversity of fishes present in Gulf waters are poorly represented amongst the bones of Qal'at al-Bahrain. The bones recorded are, indeed, the strongest anatomical parts that are collected and therefore larger fish have been identified. Many smaller species may have been also caught which are not represented. This bias could possibly be partly rectified by analysis of the sieved samples. This may offer a wider variety of species qualitatively, but this cannot be quantitatively compared, as small fish are only present in a few samples, in comparison to hand retrieved bones from larger fish species which are much more abundant.

Major problems in undertaking this study lie both in the unequal amounts of material, but also in the irregular sieving carried out within each chronological period, which does not facilitate easy comparisons between levels. Finally, some fish species are not identified to species, either because of lack of comparative skeletons, or because of their taxonomic proximity. For example, the choice to limit the identification of grouper to the genus, *Epinephelus*, is due to the morphological similarity of different species within the same genus, as well as the limited differences in their associated habitats. We believe that specific species determination is not necessary here to understand the occupation of the site.

STUDY CONDITIONS

The bone material was studied in the archaeozoology laboratory of CEPAM,¹ using the fish skeletal comparative collections made by Jean Desse and Nathalie Desse-Berset from fish caught in Bahrain and throughout the Gulf. Diversity typical of the region is well represented through the quantity of reference skeletons. Different sized fish present in the collections allow the estimation of sizes and weights for several species.

DIACHRONIC ANALYSIS OF THE FISH BONES FROM QAL'AT AL-BAHRAIN

To date, 5763 bones have been studied, including 3692, which can be determined to family, genus or species, which is an identification rate of 64%. This percentage is quite high due to the good preservation of the material. The rich faunal spectrum includes 27 genera, 18 species from 12 different families. The results presented here are based only on the hand-collected samples (Table 22.2). The elements from the

sieved samples are not yet studied in detail, although some comments can be provided on them. The best represented families during all periods are the emperors (Lethrinidae: *Lethrinus* sp.) with 1310 remains, jacks/trevallies (Carangidae: *Alecta indicus*, *Alepes mate*, *Carangoides bajad*, *Carangoides chrysophrys*, *Carangoides malabaricus*, *Gnathanodon speciosus*, *Scomberoides commersonnianus*, *Seriola dumerili*) with 816 remains, groupers (Serranidae: *Epinephelus* sp.) with 747 remains and seabream (Sparidae: *Acanthopagrus bifasciatus*, *Acanthopagrus latus*, *Argyrops spinifer*, *Cheimerius nufar*, *Crenidens crenidens*, *Rhabdosargus* sp., and *Sparidentex hasta*) with 690 remains. Eight other families are represented by smaller quantities of bones, such as mackerel, wahoo, tuna and bonito (Scombridae: *Rastrelliger kanagurta*, *Scomberomorus commerson*, *Euthynnus affinis* and *Thunnus* spp.) 53 bones, sea catfish (Ariidae: *Netuma* spp.) 27 bones, barracuda (Sphyraenidae: *Sphyraena* spp.) 20 bones, rabbitfish (Siganidae: *Siganus* spp.) 12 bones, grunts (Haemulidae: *Diagramma pictum* and *Plectorhinchus* spp.) 11 bones, needlefish (Belonidae: *Tylosurus* spp.) 4 bones, mullets (Mugilidae: *Valamugil* sp.) 1 bone, and parrotfish (Scaridae: *Scarus* sp.) 1 bone. Some cartilaginous fish are also present, as 15 vertebrae from sharks and rays were counted. Looking at the distribution of fish remains by period provides a very interesting diachronic view. The Early Dilmun period levels only contain a small amount of bones. Thus, 258 bones were analysed, including 230 which could be identified (89%). A total of seven families, 11 genera, including seven species were represented. In order of importance, are groupers (85 remains) with 37% of the total identified remains from the period, with an average size of 74 cm, emperors (62 bones or 27%), jacks/trevallies (43 bones or 19%) and seabream (36 bones or 15,5%). To these, can be added sporadic remains of tuna/mackerel and marine catfish.

In the Middle Dilmun period the number of remains are higher than that of the previous period, and taxonomic diversity is much more significant, despite the marked fragmentation. Thus, out of 582 bones studied, 237 could be identified (41%), with nine families, 14 genera and ten species being identified. The four dominant families are the same, but in different proportions. Thus, emperors dominate (104 bones or 44%), followed by jacks/trevallies (61 bones or 25,5%), groupers (30 bones or 12,5%) and seabream (33 bones ie 14%). Other families complete the spectrum, but in smaller proportions: grunts, mullets, barracuda, rabbitfish and tuna/mackerel. During the Late Dilmun period the vast amount of material (4054 items, including 2659 identified specimens (65%)) has allowed the identification of

nine families with 20 genera and 13 species. Emperors dominate (955 bones identified, or 36%), then jacks/trevallies (eight species providing 657 bones, 25%) and seabream (7 species giving 572 bones or 21,5%) and groupers (415 bones or 15,5%), whose average size is 68 cm. Five other families are represented in lower proportions: the sea catfish (21 bones), tuna/mackerel (17 bones from three species), barracuda (16 bones), needlefish and grunts (1 and 2 bones). The Tylos period only had a relatively small quantity of bones (160 bones, out of which 104 bones or 65% could be determined). This small quantity can be explained by the lack of excavation of deposits dating to these particular occupation horizons. A total of six families, 11 genera and seven species were, however, noted. The same four families dominate the spectrum, emperors (38 bones, 36,5%), groupers (27 bones, 26%), jacks/trevallies (three species, 21 pieces, 20%) and seabream (three species, ten bones, 9,5%). Tuna/mackerel and sea catfish were also poorly represented. Finally, during the Islamic period, there were 709 remains studies, of which 462 could be identified (65%), and the range of fauna represented was as varied as that during the Middle and Late Dilmun periods, with 11 fish families represented. Thus, a total of 17 genera were identified and 8 species.

In order of importance the assemblage is as a whole dominated by groupers (190 bones, 41%), whose average size is 62cm, emperors (151 bones, 33%), jacks/trevallies (34 bones, 7%), seabream (39 bones, 8,5%), tuna/mackerel (21 bones, 4,5%), rabbitfish (ten bones, 2,2%), and grunts (eight bones, 1,7%). Sea catfish, needlefish, barracuda and rabbitfish represent the remainder.

Table 22.2. Occurrence of fish species by occupation period at Qal'at al-Bahrain. Note: this only includes hand collected material from the 1989–2004 French excavations.

Family	Species	Common name	Early Dilmun		Middle Dilmun		Late Dilmun		Tylos		Islamic		Total
			NR	%	NR	%	NR	%	NR	%	NR	%	
Ariidae	<i>Netuna</i> spp.	Marine Catfish	1	0.4			21	0.8	1	1	4	0.9	27
Belontiidae	<i>Tylosurus</i> spp.	Needlefish					1	0.04			3	0.6	4
Carangidae	<i>Alectis indica</i>	Indian Threadfish					1	0.04					1
Carangidae	<i>Atule mate</i>	Yellowtail Scad			1	0.4	1	0.04					2
Carangidae	<i>Carangoides bajad</i>	Orange spotted Jack	13	5.7	12	5.1	223	8.4	4	4	6	1.3	258
Carangidae	<i>Carangoides chrysophrys</i>	Longnose Trevally	1	0.4	1	0.4	18	0.7					20
Carangidae	<i>Carangoides malabaricus</i>	Malabar Trevally			2	0.8							2
Carangidae	<i>Carangoides</i> spp.	Trevally			3	1.3	11	0.4					14
Carangidae	<i>Gnathanodon speciosus</i>	Golden Trevally	17	7.4	34	14.3	259	9.7	12	11.5	26	5.6	348
Carangidae	<i>Scomberoides commersonianus</i>	Talang Queenfish	6	2.6			71	2.7	3	2.9			80
Carangidae	<i>Scomberoides</i> spp.	Queenfish					20	0.8					20
Carangidae	<i>Seriola lalandi</i>	Greater Amberjack					6	0.2					6
Carangidae	<i>Seriola</i> spp.	Amberjack	1	0.4			5	0.2					6
Carangidae	Indeterminate		5	2.2	8	3.4	42	1.6	2	2	2	0.4	59
Total Carangidae													816
Epinephelinae	<i>Epinephelus</i> spp.	Grouper	85	37	30	12.7	415	15.6	27	26	190	41.1	747
Haemulidae	<i>Diagramma pictum</i>	Painted Sweetlips			1	0.4							1
Haemulidae	<i>Plectorhynchus</i> spp.	Sweetlips					1	0.04			8	1.7	9
Haemulidae	<i>Pomadasys</i> spp.	Grunt					1	0.04					1
Leihrinidae	<i>Leihrinus</i> spp.	Emperor Mullet	62	27	104	43.9	955	35.9	38	36.5	151	32.7	1310
Mugilidae	<i>Valanugil</i> spp.	Parrotfish			1	0.4					1	0.2	1
Scaridae	<i>Scarus</i> spp.	Narrow-barred Spanish Mackerel							4	4	1	0.2	6
Scombridae	<i>Scomberomorus</i> spp.	Kawakawa/ Little Eastern Tuna	1	0.4	1	0.4	4	0.2	1	1	14	3.0	21
Scombridae	<i>Thunnus</i> spp.	Tuna					13	0.5			3	0.6	16
Scombridae	<i>Rastrelliger kanagurta</i>	Indian Mackerel									1	0.2	1
Scombridae	Indeterminate	Tuna/ Mackerel	1	0.4			3	0.1	2	2	1	0.2	7
Total Scombridae													53
Sphyraenidae	<i>Sphyraena</i> spp.	Barracuda	1	0.4	2	0.8	16	0.6			1	0.2	20
Siganidae	<i>Siganus</i> spp.	Spinefoot/ Rabbitfish			2	0.8					10	2.2	12
Sparidae	<i>Acanthopagrus bifasciatus</i>	Double-barred Seabream	10	4.3	20	8.4	103	3.9	2	2	15	3.2	150
Sparidae	<i>Acanthopagrus latus</i>	Yellowfin Seabream					3	0.1					3
Sparidae	<i>Argyrops spinifer</i>	King Soldierbream	12	5.2	1	0.4	337	12.7	5	4.8	14	3	369
Sparidae	<i>Cheimarrus aulif</i>	Sante' Seabream					1	0.04					1
Family	Species	Common name	Early Dilmun		Middle Dilmun		Late Dilmun		Tylos		Islamic		Total
			NR	%	NR	%	NR	%	NR	%	NR	%	
Sparidae	<i>Crenidens crenidens</i>	Karanteen Seabream					2	0.1					2
Sparidae	<i>Sparidentex hasta</i>	Sobaity Seabream									1	0.2	1
Sparidae	<i>Rhabdosargus</i> spp.	Goldstriped/ Halfara Seabream	12	5.2	7	3	84	3.2	2	2			105
Sparidae	Indeterminate	Seabream	2	0.9	5	2.1	42	1.6	1	1	9	2	59
Total Sparidae													690
Identified			230	89	237	40.7	2659	65.6	104	65	462	65.2	3692
Unidentified			28	11	345	59.3	1395	34.4	56	35	247	34.8	2071
Total			258	100	582	100	4054	100	160	100	709	100	5763

Discussion

Comparison of the results with previous studies shows that throughout the occupation, four families dominate the fisheries of the inhabitants of Qal'at al-Bahrain. Their order of importance varies according to the chronological periods, these are emperors (Lethrinidae), groupers (Serranidae), jacks/trevallies (Carangidae) and seabream (Sparidae).

This dominance has already been demonstrated in previous studies (Table 22.1). However, a comparison can be made with the results obtained with material from the Danish excavations. Indeed, they are the only ones to have led to the publication of quantitative chronologically calibrated results.

In the case of the Early Dilmun period, the results obtained by Van Neer and Uerpmann (1994), with a total of 2899 identified remains, highlight the presence of groupers (36%), emperors (30%), seabream (15 %) and jacks/trevallies (15%). Three other families represent the remainder of the fauna: marine catfish (0.6%), tuna/ mackerel (0.6%) and barracuda (0.1%). Our study confirms the preference for these particular fish populations. Despite the lack of remains identified from the French excavations, the percentages are broadly equivalent to earlier results. Furthermore, taxonomic diversity is better explained in our sample. Some species, such as *Carangoides bajad*, *Scomberoides commersonnianus*, and *Acanthopagrus bifasciatus* are specifically determined, thus providing further clarification. It is likely that this diversity may be further expanded once the study of the skeletal remains retrieved from sieving is carried out.

For the following periods of occupation at both Qal'at al-Bahrain and Saar (cf. Uerpmann & Uerpmann 1997; 1999) the Middle Dilmun and Late Dilmun periods, the preference for grouper is less obvious, and the local inhabitants seem to have preferred emperors (33%), then groupers (29%), followed by jacks/trevallies (17%), seabream (14%), rabbitfish (1%), barracuda (1%), tuna/mackerel (0.6%), sea catfish (0.2%), and finally, grunts and drums (0.1% each). Our results confirm the preponderance of emperors, while groupers find themselves in fourth position, after jacks/ trevallies and seabream. Two new families complement the previous studies, needlefish and mullets. In contrast, the drums present in previous studies (Uerpmann & Uerpmann 1997; 1999) do not appear in our material. The meeting of these two studies has enriched the faunal spectrum by an additional family, and leads to a total of 11 families. In total for this period there are 15 species, seven genera and an additional family highlighted by this new study.

The preference for emperors (Lethrinidae) is confirmed during the

following Tylos period. Their remains are more frequent than those of groupers, jacks/trevallies and seabream. The remaining fish represented are tuna/ mackerel and marine catfish. During the Islamic period, groupers come first in the species consumed, followed by emperors, jacks/trevallies, seabream, tuna/mackerel, rabbitfish, grunts, sea catfish, needlefish, parrotfish and barracuda.

In general, we find throughout the occupation the same type of fish caught and eaten by the people of Bahrain island. Analysis of the fish bones from Dilmun period levels at the Saar Temple (Moon & Irving 1997) and from Islamic period levels at Bilad al Qadim (Beech 2005) identified a similar range of fishes.

Taking into account the habitat of each species, and the reconstruction of the size of the fishes, it allows us to locate possible fishing areas and to propose techniques which may have been used to capture them, as well as to quantify the relative importance of fish in the diet of the inhabitants.

Biotores of identified fishes

Eight species of jacks/trevallies (Carangidae) were determined: *Alectis indica*, *Atule mate*, *Gnathanodon speciosus*, *Carangoides bajad*, *Carangoides chrysophrys*, *Carangoides malabaricus*, *Scomberoides commersonianus*, and *Seriola dumerili*. These all evolve in the same habitat, that is to say, in coral reefs, near to shore, generally in shallow waters.

The main species of emperors (Lethrinidae) attested at the present time is *Lethrinus nebulosus*. This lives in seagrass beds and mangroves, particularly in shallow water, at least during its subadult stage. Four other species of the same genera may be determined at the present time: *L. lentjan*, *L. mahsena*, *L. microdon* and *L. borbonicus*.

Several species of groupers, which all inhabit very similar habitats (coral reefs), are present in the coastal waters of Bahrain. The choice was made for the time being, to treat these all under the generic name, *Epinephelus* spp. Their living conditions are quite similar, and accurate data on their ecology too fragmentary (Desse & Desse-Berset 2000a).

Eight species of seabream (Sparidae) are present at the site: *Acanthopagrus bifasciatus*, *Acanthopagrus latus*, *Argyrops spinifer*, *Cheimerius nufar*, *Crenidens crenidens*, *Rhabdosargus haffara*, *Rhabdosargus sarba* and *Sparidentex hasta*). The first and last live in shallow (<60m) and on sandy bottoms. *Argyrops spinifer* and *Cheimerius nufar* also live near the bottom, but respectively up to

depths of 150–300m.

In the Scombridae, four major species are currently determined. *Scomberomorus commerson* and *Rastrelliger kanagurta* live in very deep water (<70m). *Euthynnus affinis* and *Thunnus* sp. are predators of the open sea, preferring greater depths up to 250m. Thus, for exploitation of these species, it may be possible that the coastal fisheries seasonally fished in offshore waters. Among the six families found sporadically during the successive occupations, the marine catfish (Ariidae: *Netuma* spp.) are quite often demersal catch and can be found in brackish water lagoons along the coast, whilst needlefish (Belonidae: *Tylosurus* spp.) and barracuda (Sphyraenidae: *Sphyraena* spp.) are associated with reefs and shallow waters. Rabbitfish (Siganidae: *Siganus* spp.), mullets (Mugilidae: *Valamugil* spp.) and grunts (Haemulidae: *Diagramma pictum* and *Plectorhinchus* spp.) are all coastal fish, also living in shallow waters.

Thus, the majority of species exploited came from coral reefs in shallow inshore coastal waters (Belonidae, Carangidae, Serranidae, Sphyraenidae, Mugilidae and Haemulidae), mangroves and lagoons (Ariidae, Lethrinidae and Siganidae), and sandy bottoms (Sparidae).

Fishing techniques in Bahrain

The presence of both coastal and pelagic species such as tuna, suggests that different fishing techniques may have been utilised (Fig. 22.6). Archaeozoological analyses and ethno-archaeological work carried out by Nathalie Desse-Berset during her fieldwork provides useful information on the techniques used by coastal populations in Bahrain (Desse-Berset 1995). Fish traps, known locally as ‘*haddrah*’, made from date palm fronds, have a very specific form which can vary but which are usually arrow-shaped. These catch fish at low tide, and are still very much in use at the present day (Desse-Berset 1995).

Dhows, more specifically boats such as Jaliboot, Sambuk, etc., allow the local fishermen to move along shallow coastal waters (from 2–10m in depth) for distances up to around 50km. The fishermen use large basket traps of different sizes, known locally as ‘*gargoor*’, to catch fish. All of these techniques allow the capture of all species present in the levels of Qal-at al-Bahrain. Moreover, fishing with lines near to Qal-at al-Bahrain is attested by the discovery of fish hooks and stone net sinkers, particularly during the Tylos period.

It is likely that some of the techniques mentioned above were used during the successive occupations of the site. All that is certain is that the diversity of techniques utilised attests to a highly developed fishing industry which is justified by the strategic position of Bahrain

island in the Persian Gulf.

Conclusion

The diachronic study of fish bones from the Early Dilmun to Islamic periods at the site of Qal'at al-Bahrain provides valuable information concerning the economy of the capital of ancient Dilmun. One notes the pervasiveness of four main families throughout the occupation, emperors, groupers, jacks/trevallies and seabream. These fish provide the greatest amount of bones at the site, and denote various food preferences during successive periods of occupation. Other taxa complement these, but in smaller quantities.

Ongoing studies complement the earlier Danish and French studies, and confirm the results. Taking into account that some of the excavated sediment was subjected to sieving, the future analysis of this material will undoubtedly enhance the diversity of the identified assemblage, since most of the previous studies were based on hand retrieved material.

The current study provides additional qualitative and quantitative data, and allows a diachronic view of exploitation of the sea by the island populations of Bahrain. In particular, a transition from sedentary species such as groupers, towards species living in groups like emperors, along with occasional exploitation of pelagic fishes from deeper waters. The study highlights that fishing took place in mangroves/lagoons, on the open seas, on coral reefs, as well as along the coast, i.e. all aquatic environments were exploited in the vicinity of the site.

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Note

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23. Evidence for deep-sea fishing and cultural identity during the Neolithic period at Akab Island, Umm al-Qaiwain, United Arab Emirates

Mark J. Beech, Vincent Charpentier and Sophie Méry

Analysis of the fish bones from the 5th millennium BC settlement on Akab Island in Umm al-Qaiwain emirate in the United Arab Emirates provides evidence of open ocean fishing. The discovery of numerous bones of tuna, as well as the presence of shell fish hooks at the site, suggests that fishing was at least part of the time carried out from boats in the open sea, beyond the shallow waters of the local lagoon. Some fishing was also carried on in these sheltered waters, and analysis of the molluscan and crab remains indicates that mangrove areas were also exploited. Some comments are made concerning the presence of shell fish hooks at the site, as well as certain types of beads and jewellery, which reinforce the idea of a coherent regional cultural entity during the 5th–4th millennia within this region.

Keywords deep-sea fishing, tuna, shell fish hook, 5th millennium BC, United Arab Emirates

Introduction

Between the Gulf and the Arabian Sea all the Neolithic settlements which have been excavated within the Oman peninsula are coastal sites. This is probably explained by the fact that this type of site is more easily detected and suffers less from deflation due to aeolian processes and the mobility of sand dunes on those sites located within the interior. These coastal habitats sometimes have significant

stratigraphy, such as more than 2m thick, for example, in the case of the 5th–4th millennium BC site of Suwayh 1 in the Sultanate of Oman (Charpentier 2008). Due to the presence of large quantities of marine shells at these sites, the relatively high calcium carbonate content ensures that animal bones are much better preserved within these ‘shell-middens’. This is particularly the case for stratigraphic levels associated with the 5th millennium BC settlement on Akab Island (UAE), which is characterised by a high degree of mineralisation.

Today, all of these Neolithic coastal sites reveal a material culture which is often a reflection of human activities related to the sea (Beech 2002; 2004). At the settlement of Akab, the presence of ceramic remains provide evidence of long distance maritime trade with the northern Gulf and the Ubaid Culture of Lower Mesopotamia, in particular. This article presents another aspect of the relationship between populations in the Gulf during the 5th millennium BC: not only fish production, but the conquest of the sea.

Akab Island, Umm al-Qaiwain emirate, United Arab Emirates

Akab Island is located 50km north of Dubai in the large lagoon of Umm al-Qaiwain in the United Arab Emirates (Fig. 23.1). The archaeological site, first investigated by a palaeontologist at the beginning of the 1990s, was initially interpreted as a butchering area for dugongs, and thus became known as the oldest known site of dugong hunting within the Gulf (Priour & Guérin 1991; Jousse *et al.* 2002).

Subsequent excavations carried out by the French Archaeological Mission to the United Arab Emirates (FAMUAE) revealed that the dugong mound of Akab was only a small part of a much larger Neolithic site, periodically occupied in the 5th millennium BC, which included the remains of circular habitations (Charpentier & Méry 2008). Radiocarbon dating indicates that this settlement was occupied between around 4700–4100 BC. In the 4th millennium BC, except for the dugong mound, traces of human occupation were more ephemeral, probably because they had been partially destroyed by deflation.

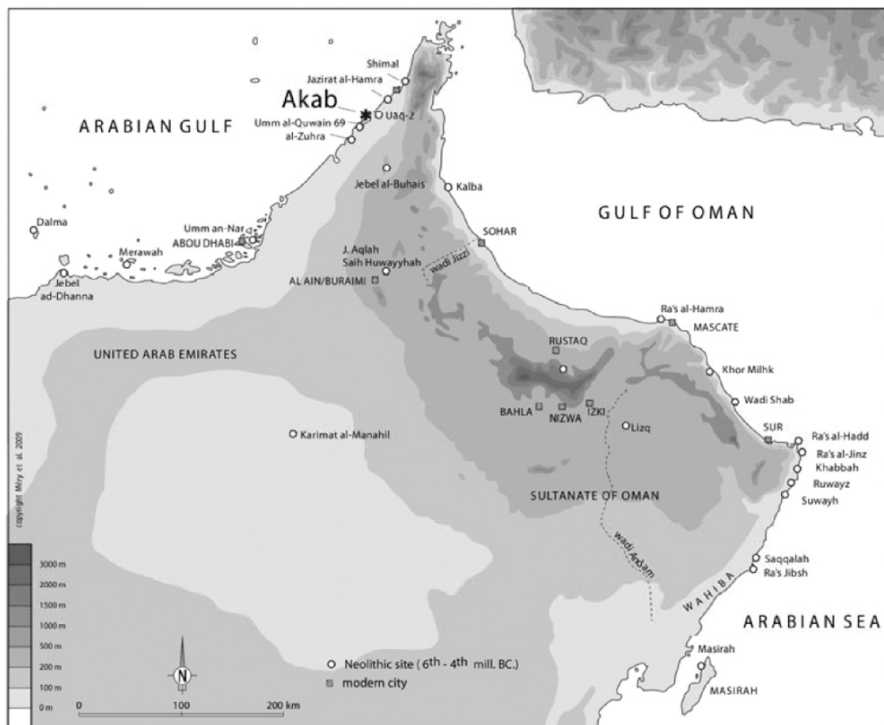


Fig. 23.1. Location of the site of Akab (source: French Archaeological Mission in the UAE).

In 2006–8 the excavation of the dugong mound was resumed by a multi-disciplinary team of prehistorians and faunal experts (Charpentier & Méry 2012; Méry *et al.* 2009, Méry & Charpentier 2012). The hypothesis of a butchering site, which had been advanced previously, was rapidly put into question when the mound was discovered to be a *structured* accumulation of bones, a complex arrangement whose layout had been accomplished in stages. This structure was built on a hillock of wind-blown sand and consisted of at least two stratified levels, about 40cm in height. Radiocarbon dating of a dugong bone sample attributed it to the 2nd half of the 4th millennium BC (5140 ± 55 BP, Pa-2433, ca. 3568–3116 cal BC). The dugong bone platform contained the remains of about 40 dugongs. Its base consisted of mandibles laid flat, wedged by ribs. This provided a foundation upon which the skulls were placed upright in anatomical position. The skulls were carefully wedged by ribs (Fig. 23.2), and were arranged in a deliberate manner, with a row of eight aligned at the front. Adults, as well as juvenile, including very young, dugongs were well represented. No animal appears to have been deposited whole in the structure. Certain elements such as ribs, vertebrae and

limbs were under-represented, which means that there is evidence of intentional selection (Méry *et al* 2009; cf. also Beech 2010, regarding the selection of particular elements of dugongs).

Several hundred objects were deposited in or inserted into this mound of dugong bones. These mainly consisted of ornamental jewellery in the form of beads (*Spondylus* sp, *Pinctada* sp., *Ancilla* sp., etc). The Neolithic dugong bone mound at Akab is now interpreted as a monument with pre-conceived organisation which represents the oldest known ritual site in Arabia (Charpentier & Méry 2012; Méry *et al.* 2009; Méry & Charpentier 2012).

The purpose of this paper, however, is to discuss the preliminary analysis of the environmental remains associated with the earlier 5th millennium BC settlement site.



Fig. 23.2. Part of the ritual dugong bone platform – the dugong skulls at Akab are placed in anatomical position, aligned and wedged by ribs (source: French Archaeological Mission in the UAE).

The 5th millennium settlement site

Five excavation campaigns, carried out since 2002 by the French Archaeological Mission to the UAE, showed that the site of Akab had multiple occupations, dated by radiocarbon, to between 4750 and 3120 BC. Most of the excavated levels date back to the 5th millennium BC (Charpentier & Méry 2008). The site, which exceeds more than an acre (0.45ha), includes anthropogenic deposits without a trace of any major discontinuity for more than half a millennium. The remains of

architectural traces in the form of post-holes indicate the repeated construction of structures during the 5th millennium BC.

No significant abandonment phase has been identified at the site, which was not occupied until after 3100 BC. The site was abandoned during a period corresponding to the late Neolithic in the Oman Peninsula, a period consistent with a phase of aridification. No significant later remains have been discovered on Akab Island, but some remains dating to the Islamic period are attested, including fire places.

Akab 2002 excavations – some preliminary results of the environmental remains

The first author was asked to undertake an analysis of the archaeozoological remains from the 2002 excavations at the Akab settlement site. All material was identified using the first author's comparative osteological collection of the Gulf mollusca, crabs, fish and marine shells from the region, which is curated in Abu Dhabi in the United Arab Emirates. Quantification of the material was made using a rapid semi-quantitative system as indicates in [Table 23.1](#).

Molluscs

At least six families of mollusc are present at the site ([Fig. 23.3](#) & [Table 23.1](#)). These include an as yet undetermined species of Cerithiidae, *Terebralia palustris*, *Cypraea* sp., an undetermined species of Dentaliidae, *Pinctada* sp. and *Spondylus* sp.

The presence of *Terebralia palustris* in three levels at the site (S1 L1; S2 L6; and S5 G9 L6) is of some interest here. This large gastropod, known as a mudcreeper, prefers intertidal habitats on the surface of mud in mangroves and soft water logged soil. Large quantities of these have been found within the Gulf at a number of prehistoric sites in the northern Emirates. They used to form a major food resource in ancient times. This species is, however, now extinct within the Gulf. It can only be found in a small number of locations on the east coast of the UAE at the present time. Its extinction within the Gulf may be due to the loss of suitable mangrove habitats along the coast due to the over-exploitation of mangroves for timber and fodder.

Some of the pearl oyster shell fragments (*Pinctada* sp.) are very large (S5 L5), and appear to belong to the species, *Pinctada margaritifera*. A total of 18 pearls was found during the excavation of the settlement, when sieving the sediments (Charpentier *et al.* 2012). Pearl oysters would clearly have been gathered as a food item, as well as for their pearls.

Crabs

Two types of crabs were identified amongst the Akab material (Fig. 23.3 and Table 23.1). The most common type represented was swimming crabs, Portunidae, from the genus *Portunus* sp. The remains of these predominantly consisted of their characteristic elongated *chelae* (pincers). The second less common type was the mud or mangrove crab, *Scylla serrata*. This had much more massive *chelae* with large molariform teeth.

Large quantities of *Portunus* crab remains were noted in some levels of the site (S1 L1 and S2 L6), and moderate levels in others (S2 L5; S5 G8 L6; S5 G9 L6; and S5 L6-7). The remains of *Scylla serrata* were only discovered in two levels at the site (S1 L1 and S2 L6). These same levels also contained examples of the gastropod species, *Terebralia palustris* (see above), confirming that mangrove environments were being exploited during these particular occupation horizons.

Table 23.1. Marine Mollusca and crabs identified from the 5th millennium BC settlement at Akab

COMMON NAME	FAMILY	TAXON	S1	S1	S1	S1	S1	S1	S1	S1	S2	S2	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3
			L1	L1	L2	L1	L1-2	L1	L1	L1	L2	L5	L6	L1A	L1	2e passe	3e passe	4	L2	G8	G9	G9	G9	G9	G9	G9
			C1	C3	D1	D2	D3	D4	E1	E1	C4					22/01/2002			C4	L6	19-4	1.6	75-90cm	1.6	1.6-7	1.6
Cerith	Cerithiidae	indeterminate	+																							
Mudcrab	Portunidae	<i>Terebralia palustris</i> (Linnaeus, 1767)	+																							
Coverlet	Cypridae	<i>Cyprina</i> sp.																								
Elephant tank shell	Dentaliidae	indeterminate																								
Pearl oyster	Phoridae	<i>Pinna</i> sp.																								
Spiny oyster	Spondyliidae	<i>Spondylus</i> sp.																								
Mollusc indeterminate		Mollusc, indeterminate																								
Swimming Crab	Portunidae	<i>Portunus</i> sp.																								
Mud/Mangrove Crab	Portunidae	<i>Scylla serrata</i> (Forssk., 1775)	***																							
Shark		Chondrichthyes, indeterminate	+																							
Marine Catfish	Ariidae	<i>Arius</i> sp.																								
Needlefish	Belontiidae	indeterminate																								
Grouper	Serranidae	<i>Epinephelus</i> sp.																								
Golden Trevally	Carangidae	<i>Gnathodon</i> sp.																								
Jack/Trevally	Carangidae	<i>Lepturus</i> sp.																								
Subreem	Serranidae	<i>Bludius</i> sp.																								
Emperor	Labridae	<i>Labrus</i> sp.																								
Baranada	Sphyraenidae	<i>Sphyraena</i> sp.																								
Tuna/Mackerel	Scombridae	Thunninae, indeterminate																								
Fish indeterminate		Pisces, indeterminate																								
Sheep/Goat/Gazelle	Bovidae	<i>Ovis</i> or <i>Capra</i> or <i>Gazella</i> indeterminate																								
Gazelle	Bovidae	<i>Gazella</i> sp.																								
Dog	Canidae	<i>Canis lupus familiaris</i> (Linnaeus, 1758)																								
Dugong	Dugongidae	<i>Dugong dugon</i> (Müller, 1776)																								
Mammal indeterminate		Mammalia, indeterminate																								
Human		<i>Homo sapiens</i>																								

+ = single example, * = 2-9 examples, ** = 10-49 examples, and *** = 50+ examples

Fishes

The majority of the environmental remains retrieved from the excavations consisted of fish bones (Table 23.1 & Fig. 23.4). This demonstrates the importance of fishing to the peoples of the lower Gulf during the Neolithic period. At least nine families of fishes are

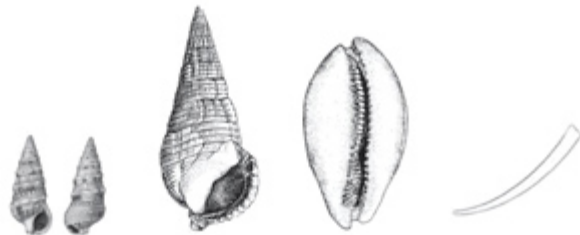
present at the Akab site including sharks (Chondrichthyes, indet.), marine catfish (Ariidae), needlefish (Belonidae), groupers (Serranidae), jacks/trevallies (Carangidae), seabream (Sparidae), emperors (Lethrinidae), barracudas (Sphyrnaeidae) and tuna (Scombridae: Thunninae).

A single large shark vertebra was identified. This came from a requiem shark (Carcharhinidae). Judging from the relative size of the vertebra the shark must have been at least 2m in length. Marine catfish (Ariidae) were represented by neurocranial fragments as well as by otoliths. Needlefish (Belonidae) were identified in six levels by dentaries, premaxillae and vertebrae fragments. Groupers (Serranidae) occurred in three levels. These all belonged to the genus *Epinephelus*. Jacks/trevallies (Carangidae) were quite common in the material, occurring in nine levels. Some of these remains belonged to the golden trevally (*Gnathanodon speciosus*). Seabreams (Sparidae) were represented in five levels by the genus *Rhabdosargus*, identified on the basis of its characteristic oval rear molar, present in both its dentary and premaxilla. Emperors (Lethrinidae) were represented by a single otolith from the genus *Lethrinus*. A single dentary from barracuda (Sphyrnaeidae) was noted. Bones from tuna (Scombridae: Thunninae) occurred in no less than eight levels at the site, being common in level S5 G9 L6. These all consisted of vertebrae, which judging from their relative size probably belonged to fishes around a metre or less in size. The species *Thunnus tonggol*, known as longtail tuna, is the type of tuna commonly sold in fish markets in the UAE at the present day. This generally attains a maximum length of only 140cm (Randall 1995). It may well be this relatively small tuna which was also caught in the past.

Mammals

At least three types of mammals were recorded (Table 23.1). Some small bone fragments could only be classified as belonging to either domestic sheep/goat or gazelle. At least two specimens, a calcaneum and 2nd phalanx, could be definitively assigned to gazelle. An almost complete 3rd metatarsal was identified as belonging to dog (from level S5 3^e passe). The commonest mammal occurring in the deposits at Akab was dugong. Traces of this animal in the form of skull, rib and vertebrae fragments occurred in 16 out of the 24 units or levels excavated at the site. This confirms the importance of Akab for the hunting and exploitation of dugong.

A



B



Fig. 23.3. Marine molluscs and crabs identified from the 5th millennium BC settlement at Akab. From left to right: A. Top: *Cerithium*, *Terebralia palustris*, *Cypraea* sp. and *Dentaliidae*; Centre: *Pinctada margaritifera* and *Spondylus* sp. B. Bottom: *Portunus pelagicus* and *Scylla serrata*.

Finally, a small fragment of what appears to be a human vertebra was noted in level S1 L1 D1. Special care should be given during future excavations at the site to check whether further human skeletal material is present in this part of the site. It should be noted that the nearby broadly contemporary site excavated by Carl Phillips consisted of midden material in association with a cemetery (Phillips 2002).

Discussion

During the 5th millennium BC on Akab Island, it is clear that resource exploitation primarily concentrated on mangroves and on the local lagoon environment, but the inhabitants also fished for tuna on the

high seas. This meant that they had to use boats (although we do not have any direct remains of these), and fishing gear suitable for deep water fishing. Although the net weights are quite small and few in number, it was noted that the inhabitants of the site were making shell fish hooks (Mery *et al.* 2008). This is contrary to the hypothesis raised by Margarethe and Hans-Peter Uerpmann (1996), who suggested that these technologies were absent during the time the lagoon of Umm al-Qaiwain was first occupied.

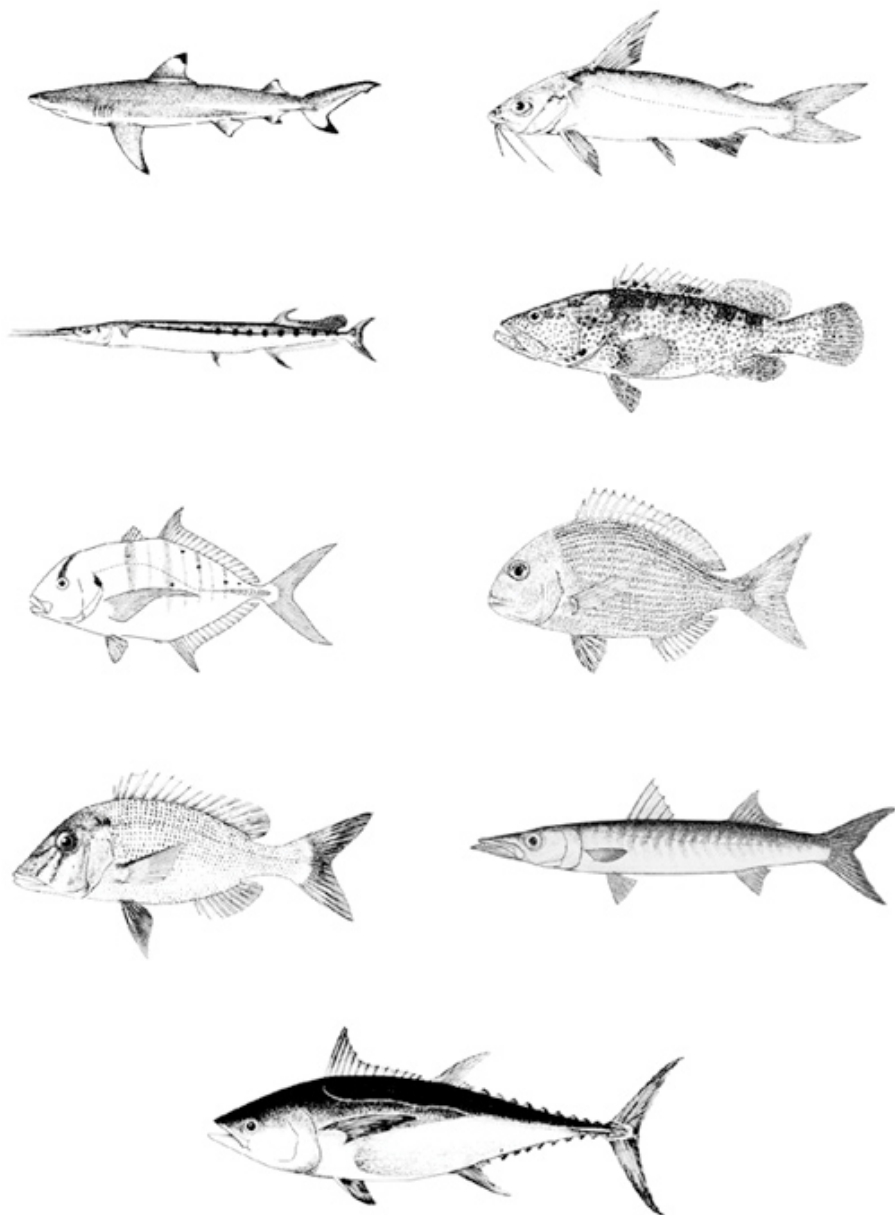


Fig. 23.4. Marine fishes identified from the 5th millennium BC settlement at Akab. From left to right: Top: Carcharhinidae: *Carcharhinus melanopterus* and Ariidae: *Arius thalassinus*; 2nd row: Belonidae: *Ablennes hians* and Serranidae: *Epinephelus coioides*. 3rd row: Carangidae: *Gnathanodon speciosus* and Sparidae: *Rhabdosargus sarba*; 4th row: Lethrinidae: *Lethrinus nebulosus* and Sphyraenidae: *Sphyraena putnamiae*; Bottom: Scombridae: *Thunnus tonggol*.

Assuming that much of the environmental material from Akab was retrieved locally, the presence of the gastropod species, *Terebralia palustris*, as well as the mud crab, *Scylla serrata*, suggests that the site was located in the vicinity of mangroves. Neither of these species are now present in the Umm al-Qaiwain area. Although some mangrove cover occurs in this area at the present time, this is largely concentrated on the eastern side of Akab island and towards the central area in the Umm al-Qaiwain lagoon (Al-Ghais & Cooper 1996, 411, fig. 1). It may be the case that mangrove habitats were more widespread in the past (Beech & Hogarth 2002).

A modern study of crabs in the Umm al-Qaiwain lagoon noted three species of swimming crabs (Portunidae), *Portunus pelagicus*, *Thalamita crenata* and *Thalamita poissoni* (Al-Ghais & Cooper 1996, 423–425). It was reported that *Portunus pelagicus* was the largest and most commonly encountered species in the area. Much of the archaeological crab remains from Akab probably belong to this species judging from their relative size. *P. pelagicus* is commonly found in shallow sublittoral waters and can even be caught offshore in locally-made gargoor fish traps by traditional fishermen.

It is clear from an examination of the types of fish caught at Akab that fishing largely took place in shallow water habitats. A study of the modern fishes present within the Umm al-Qaiwain lagoon reported moderate numbers of requiem shark, *Carcharhinus dussumieri* and marine catfish, *Arius thalassinus* (Department of Fisheries 1984). At least three species of grouper were noted, *Epinephelus areolatus*, *E. coioides* and *E. polylepis*, although only *E. coioides* was abundant. A number of jacks/ trevallies were common within the lagoon, *Gnathanodon speciosus* being particularly abundant. The seabream species *Rhabdosargus sarba*, emperors (*Lethrinus* spp.) and barracudas (*Sphyraena* sp.), were all reported as being abundant within the lagoon. Thus, the majority of the species represented amongst the archaeological material are still present in the lagoon today. Such fish could have been caught using various techniques including tidal traps (known locally as 'hadrah'), nets, basket traps, as well as the

occasional use of hook and line.

Similar evidence that much fishing was carried out in local shallow waters was obtained from other 5th millennium BC excavations in the vicinity of Umm al-Qaiwain (Beech 2003; 2004; Uerpmann & Uerpmann 1996), as well as at the nearby later site of Ed-Dur (Van Neer & Gautier 1993).

Whilst the majority of the fish could have been caught in the neighbouring Umm al-Qaiwain lagoon, tuna (Scombridae – Thunninae) were probably caught outside the lagoon in open waters. Their presence was not noted in the study of modern fishes caught within the lagoon (Department of Fisheries 1984). An important point to bear in mind is that whilst small quantities of tuna can be caught all year round they are far more abundant at certain times of year in the Gulf waters of the northern emirates. For example, in Ras Al-Khaimah waters most of the annual catch of tuna was caught during the months of April and May during 1982 (Ali & Cherian 1983). The catching of tuna may have therefore been seasonal.

Bead making and jewellery

The presence of numerous traces of *Spondylus* shell bead production in all settlement levels was another important finding. It indicates that some sites within the Gulf were specialised in craft production (Charpentier & Méry 2008; and cf. the production of *Spondylus* beads at As-Sabiyah in Kuwait; Carter & Crawford 2010).

The bead-making remains are indeed extremely abundant and occur throughout the stratigraphy of the site. In addition, even if we have no indication of manufacture of the famous ‘Akab type’ of tubular beads (made from chlorite and murex), their discovery in the 5th millennium BC settlement at Akab suggests that they are not a chronological marker at the very end of the 4th millennium, but rather a cultural marker. Indeed, they appear from around 4600 BC and persist until about 3100 BC, such beads having been discovered on sites ranging from Qatar to Oman. It should be noted that this is the first time, in southeast Arabia, that we can observe such a wide distribution of Neolithic ornamental elements. Their distribution (with the exception of Qatar) corresponds with two other types of ornamental elements very characteristic of the Neolithic of this region; namely, laurel leaf-shaped pendants made from *Pinctada margaritifera* and composite bracelets carved from large Conidae (Charpentier & Méry 2008).

Regional cultural identity

The archaeological excavations at Akab are not the only excavations to be carried out on coastal Neolithic sites in the UAE, but they do represent the first investigation of this type of site that has been conducted over such a large area, with 70m² total surface being excavated down to virgin soil. Data on the Neolithic period are scarce in the Gulf, where only a few coastal sites have been excavated or surveyed, for instance Dalma and Marawah in the United Arab Emirates, Al-Markh in Bahrain, Khor and Shagra in Qatar, and As-Sabiyah in Kuwait (Roaf 1976; Desse 1988; Flavin & Shepherd 1994; Uerpmann & Uerpmann 1996; Beech & Elders 1999; Beech *et al.* 2000; 2005; Beech & Glover 2005; Carter & Crawford 2010). Important issues concerning the chronology of the Neolithic across southeast Arabia remain to be resolved, as well as the lifestyles of local people and their trading networks. The role of indigenous cultures in the appearance of these early societies remains to be determined, as well as the influence of the PPNB of the Levant in the emergence of the Neolithic within the Oman Peninsula.

If one considers the bead making and other jewellery items discovered on coastal Neolithic sites, these observations support the hypothesis of a common cultural entity within the Oman Peninsula during the 5th–4th millennia BC. Recent studies of flint arrowheads have also helped to define a similar geographic area, two distinct areas being recognised with distinct regional techno-cultural characteristics for the period 6500–3800 BC (Charpentier 2008). The fact that some technology, including the use of pearl shell fish hooks, was shared by the coastal populations of the UAE and the Sultanate of Oman, reinforces the image of a coherent regional cultural entity during the 5th–4th millennia within this region.

This new evidence that the people living in the Akab settlement were able to venture out on the high seas, fishing beyond the safety of their own lagoon for tuna, shows that Neolithic peoples had indeed developed ocean-going boats. The fact that shell fish hooks are only known within the Gulf from two locations, Akab in Umm al-Qaiwain and Shimal in Ras Al-Khaimah, both located in the northern Emirates, may be a reflection that both these areas have deeper water in close proximity, compared with other areas with much shallower waters in the southern and western sides of the Gulf. This may also have helped to reinforce connections between these people and those living on the coast of the Sultanate of Oman, who also fished for tuna using similar technology.

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Part 6

Rituals and animal deposits

24. Elite equids 2: seeing the dead

Jill A. Weber

Cuneiform documents dating to the mid- to late- 3rd millennium referenced a special type of equid, a kunga, that inhabited the elite world of gods, kings, and diplomats. Textual references to the animals' mixed parentage elicited expectations that these were hybrid equids – likely a cross of the domestic ass x wild onager, both of which were mentioned along with the kunga. Despite these references, clear evidence for such animals had never been found in archaeological contexts. Analysis of more than 30 complete and nearly-complete skeletons from an elite burial complex dating to the 2nd half of the 3rd millennium at the northern Syrian site of Umm el-Marra has changed that. These animals, which form a single population, conform neither to populations of ass, hemione, nor horse. Hybridity is indicated by the unique combination of morphological features, the absolute size and proportions of the bones, and the large degree of dental malocclusion. Their burial context and demographic patterning further link these hybrids to the ancient kunga.

Keywords Hybrids, equids, Syria, 3rd millennium, Umm el-Marra, kunga

An elite burial complex dating to ca. 2600–2200 BC has been uncovered at the site of Umm el-Marra in northern Syria (Schwartz *et al.* 2003; 2006) (Fig. 24.1a). Nine stone-built tombs have been identified to date in this complex, which occupies the site's central acropolis (Fig. 24.1b). The monumental tombs contained multiple human inhumations and grave goods, including precious metals, ceramic vessels, and animal bones. Animal bones inside the human-occupied tombs included sheep, goat, cattle, geese, ducks and dog. A unique feature of Umm el-Marra's burial complex is the separate

inhumation of at least 40 male, draft equids (Schwartz *et. al.* 2006; Weber 2008). Initial analysis indicated that these skeletons – of which 25 are complete – were distinct from known populations of *Equus asinus*, *E. hemionus* (and sp.), and *E. przewalski*. Instead, they displayed mixed morphometric characteristics of both donkey and hemione. The context in which the animals were found – an elite burial complex dating to the mid- to late 3rd millennium, BC – suggested correlation to the elite *kunga* equid documented in contemporary texts from Syro-Mesopotamia. Largesized males of that breed were specifically used to pull the vehicles of the ruling elite and the earthly representatives of the gods (Heimpel 1994, 11; Maekawa 1979, 111–13; Zarins 1976, 450–561). The sterile *kunga* is largely considered to have been a hybrid produced from donkey and hemione parentage. The mixed morpho-metric traits of Umm el-Marra's skeletons and their culturally-appropriate identification with the *kunga* support their identification as hemione x donkey hybrids.

An initial report on the earliest of these animals excavated was given at ASWA 8 in Lyon, and subsequently published in its proceedings (Weber 2008). In the three years since the ASWA 8 conference, more skeletons have been excavated and greater effort has been devoted to providing taxonomic clarity to these finds. This work has involved the documentation and morpho-metric analysis of a larger number of bones. The results of these latest efforts are a better understanding of their intra-population variation, and a better ground for comparison between the Umm el-Marra archaeological population and other known equine populations. As this dataset grows, so too does the likelihood that it is representative of the ancient population of which the animals were part (e.g. the Law of Large Numbers). The fact that there are 30 or more independent examples of most elements makes normative statistics possible (e.g. Central Limit Theorem) and thus adds significance to statistical analyses and comparisons with other populations. Such a large collection – among the largest collections of complete equid skeletons from a single taxon of either modern or archaeological origin – enables unprecedented examination of intra-population variability of equids from the ancient world.

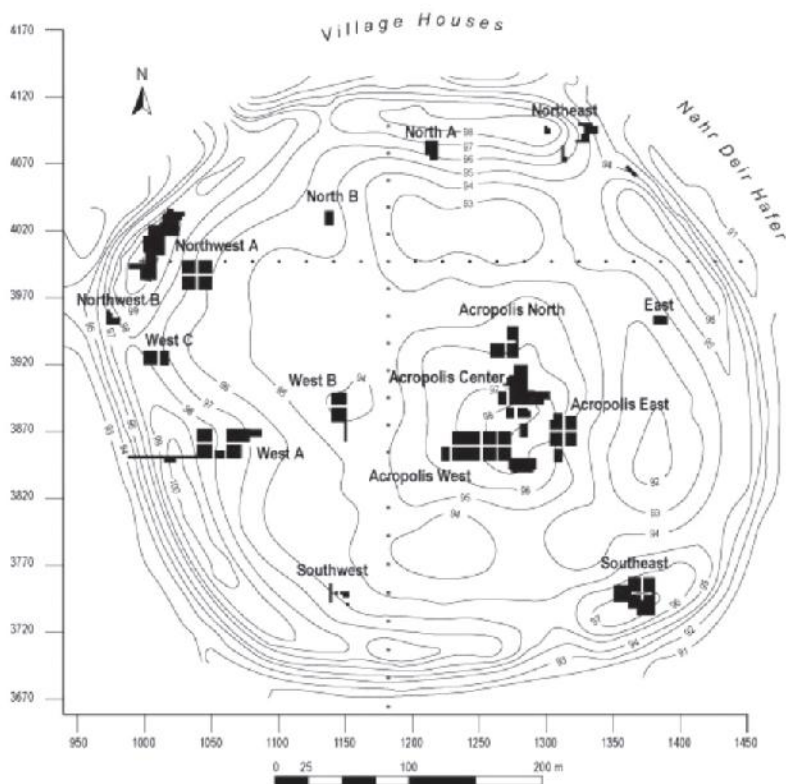
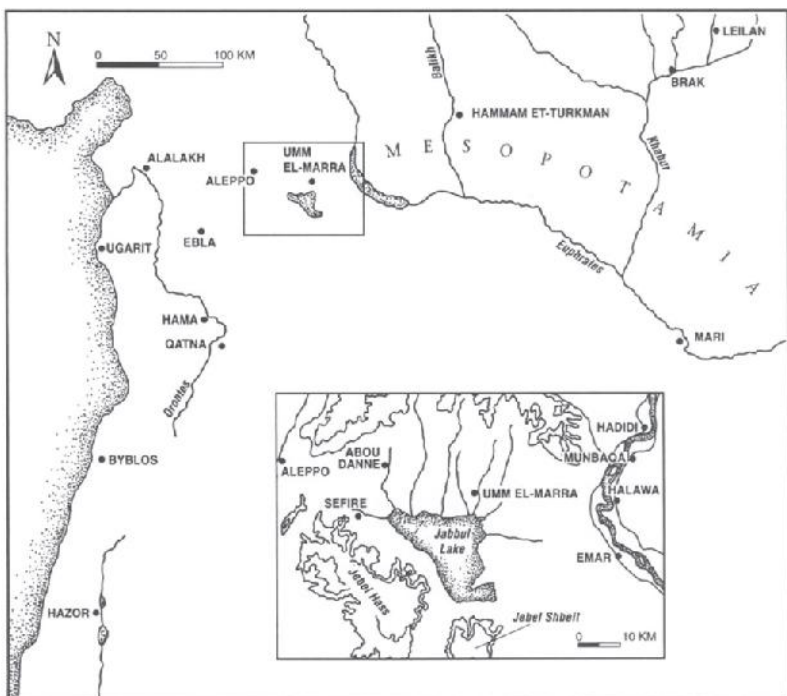


Fig. 24.1. a. Location of Umm el Marra; b. Location of different excavated

The last few years have also heralded the initiation of a 3-D modelling and archiving programme involving 3-D laser scanning of all of the equid bones from the burial complex. This will culminate in the complete, virtual preservation of the skeletons with the resulting ability to broadly disseminate the ‘raw’ bones as well as their derived documentation. The resulting models retain the superficial appearance of the originals, and impart extraordinary topographical information that may aid in the identification of new areas for equine morphometric discriminations. The 3-D data is manipulable and infinitely reproducible, allowing broad access to primary materials for present and future examination. This is of extreme importance as the bones remain in Syria, and will do so for the foreseeable future.

Results obtained from the more recent excavations and analyses will be emphasised here. Description of the population’s traits and proper classification continue, and we await preliminary results of genetic testing.

New excavations

Excavations in 2008 brought clarity to some installations that had been incompletely excavated, and also increased the number of complete skeletons to 25, with partial skeletons of a minimum of 15 more individuals (Table 24.1). An example is the so-called ‘Grey Lined Pits’ that were partially exposed in 2006. It now appears that these are two separate installations superimposed one above the other. The earliest is the single equid skeleton discovered in 2006 (Weber 2008). That individual was laying on its right side with its head in the baulk to the west; its skull has not yet been recovered. Directly above this individual was a larger pit – called Installation G1 – that contained two levels of at least four individuals each. The first, lower level contained fully articulated bodies lying on their left sides. All skeletal elements were recovered except for the skull of the northernmost individual. This was disturbed or removed when the second layer of equids was deposited immediately above the lower layer. The later, upper layer contains two fully articulated skeletons, as well as two groupings of disarticulated bones. Each grouping contains the bones of at least two individuals, but these may represent the same two individuals. The newly excavated animals do not differ from those already excavated: all are male, draft equids.

Table 24.1. Skeletons per installation.

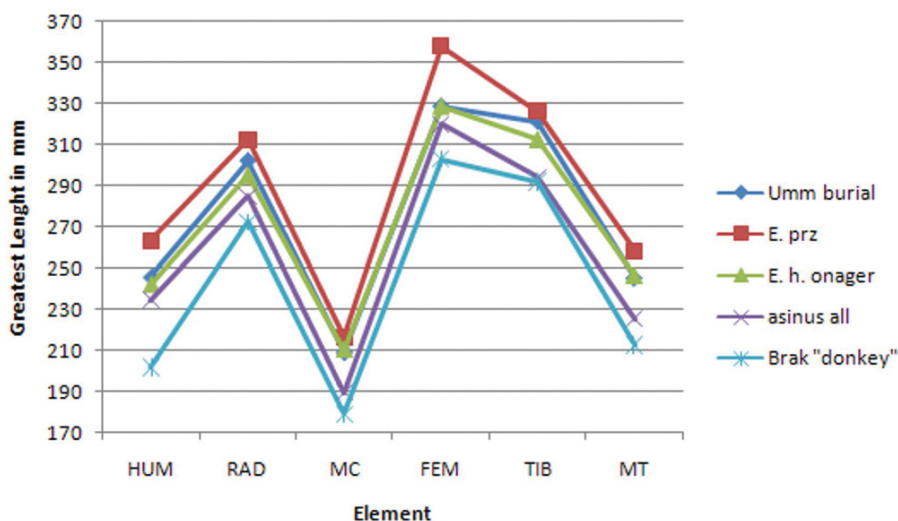
	Primary, complete individuals	Secondary and partial individuals
Installation A	4	1
Installation B	2	1
Installation C	2	0
Installation D	2	4
Installation E	4	2
Installation F	4 (?)	Unclear
Installation G	6	5
Single skeletons	1	2*

*possibly disturbed individuals from Installation F

Table 24.2. Summary of select measurements of equine taxa

Element	n	Umm el-Marra burial equids			n	E. hemionus onager			n	Equus przewalski		
		mean	sd	V		mean	sd	V		mean	sd	V
Humerus	17	245.3	11.93	4.86	31	241.9	8.14	3.365	42	263.2	9.88	3.75
Radius	25	301.4	10.43	3.46	30	295.1	10.73	3.64	40	312.2	10.795	3.45
MC	32	209.2	5.65	2.70	33	210.2	7.35	3.50	50	216.6	7.29	3.37
Femur	11	328.8	9.99	3.04	29	328.9	10.03	3.05	43	357.6	13.64	3.81
Tibia	18	320.6	9.10	2.84	30	312.6	9.80	3.13	44	326.1	12.18	3.73
MT	30	245.7	5.82	2.37	32	246.3	8.87	3.60	50	257.9	8.035	3.115
PHI A	31	79.1	2.70	3.41	31	76.3	2.485	3.26	43	79.1	3.46	4.38
PHI P	32	72.7	3.14	4.32	31	70.6	2.47	3.50	41	74.9	3.81	5.09
Me/Rad	21	69.4	2.76	3.98	30	71.3	2.86	4.01	40	69.5	2.23	3.20
MC slend	28	14.0	0.69	4.97	33	12.7	0.72	5.67	50	14.45	0.80	5.56
MT slend	26	11.5	0.63	5.46	32	10.55	0.625	5.92	50	11.55	0.58	5.06

Element	n	Equus asinus			n	Equus africanus			n	Mules		
		mean	sd	V		mean	sd	V		mean	sd	V
Humerus	31	234.6	36.28	15.47	12	248.3	11.91	4.80	16	284.7	35.17	12.35
Radius	33	284.8	43.15	15.15	12	296.0	11.94	4.03	16	331.5	40.18	12.12
MC	50	189.4	23.17	12.23	14	201.6	7.27	3.60	19	227.25	27.51	12.105
Femur	32	319.9	46.20	14.44	13	337.9	18.97	5.61	17	387.6	48.55	12.53
Tibia	33	294.0	65.48	22.27	13	312.6	16.41	5.25	16	355.25	39.53	11.13
MT	44	225.5	25.11	11.14	15	237.1	8.95	3.78	19	268.9	28.18	10.48
PHI A	38	73.9	11.22	15.19	14	76.5	4.13	5.40	16	88.3	13.475	15.26
PHI P	36	68.65	10.33	15.0	15	72.4	4.40	6.07	17	83.65	12.59	15.05
Me/Rad	31	66.7	2.67	4.00	12	68.0	1.22	1.79	15	68.1	2.06	3.02
MC slend	50	13.7	1.08	7.88	14	13.4	0.63	4.69	19	14.3	1.35	9.43
MT slend	44	10.8	0.95	8.74	15	11.1	0.63	5.72	19	11.5	1.25	10.87



Absolute size and proportional differences of limb bones between taxa

In order to work out some of the more gross metrical characteristics of the Umm el-Marra burial skeletons, collections of measurements from other equine populations were compiled. This job was made much easier by the existence of a website established by Vera Eisenmann (vera-eisenmann.com) containing thousands of measurements from samples of multiple modern and extinct equine populations. Long-bone measurements (and select others) from a selection of those populations plus persian onager measurements from Eisenmann and Mashkour (2000), as well as the author's Umm el-Marra measurements, are summarised in [Table 24.2](#). Unless otherwise noted, all figures contain measurements collected from those sources.

Relative lengths

Initial examination of the Umm el-Marra burial material suggested that these were relatively large animals – larger than the contemporary donkeys found at Umm el-Marra and roughly the size of onager found at the same site. Measurements from additional skeletons have further validated this supposition. The mean values of the greatest lengths of the long bones of the burial equids are intermediate between Przewalski's horse and domestic ass, and are roughly equivalent to, though slightly larger than, the Persian onager ([Fig. 24.2](#)). They have greater means than do modern donkeys, which includes animals bred for large size, and are much larger than the six mid-3rd millennium 'donkeys' excavated at Tell Brak (see Clutton-Brock 1989; Clutton-Brock & Davies 1993).

As is evident from [Figure 24.2](#) limb proportions are roughly similar across equid taxa, though there are measureable differences. According to Groves and Willoughby (1981, 328), on average the metatarsus is always shorter than the humerus in horses and asses, but longer in hemiones; mules also appear to have relatively shorter metatarsus bones (Willoughby 1974, 436, table 32; [Fig. 24.3](#), here). The mean greatest lengths of these two elements have nearly the same value for Umm el-Marra's burial population; the average metatarsus GL is only 0.4mm longer than the average humerus GL. Only 13 individuals have GL preserved for both the humerus and matched metatarsus. Of these, seven (54%) have metatarsus bones averaging 6.4mm longer than their matched humerus, five (38%) have metatarsus bones averaging 7.9mm shorter, and one has both bones of

equal length. In this feature, Umm el-Marra’s burial equids show greater variation than do other populations, which may be a result of the small sample size. It falls closest to the variation expressed by the Persian onager, of which 21 of 30 (70%) individuals had, as expected, longer metatarsus than humerus bones. Measurements of *E. przewalski* show 75% (30 of 40) conformity to the expected larger greatest length of the humerus. The domestic ass expressed still less variation in this regard – even despite the inclusion of animals bred to a wide range of sizes – with 25 of 30 (83%) individuals having the expected longer humerus/shorter metatarsus pairing. A wild ass population showed no individuals (n=12) deviated from the expected result: 100% had a longer humerus than metatarsal bone.

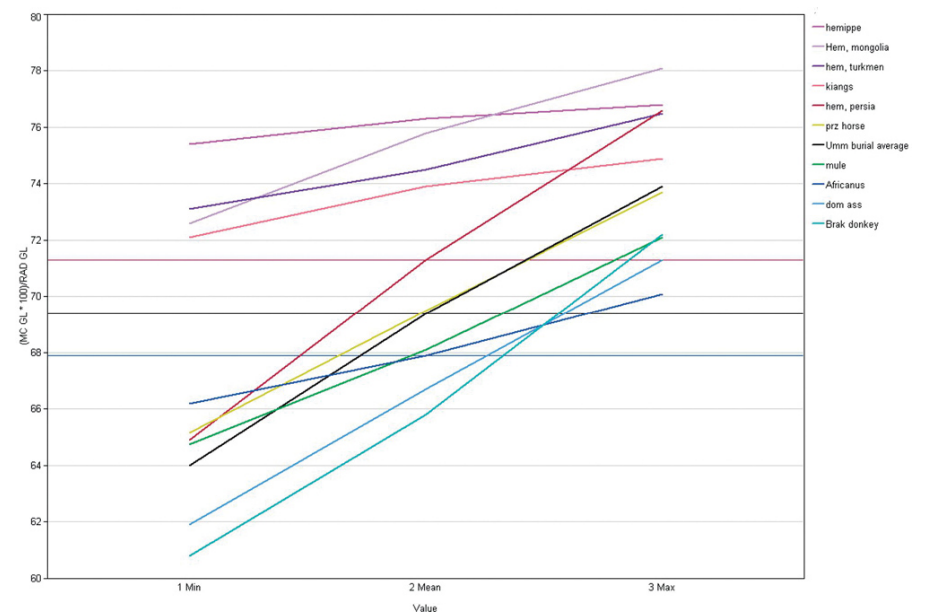


Fig. 24.3. Comparison of values between taxa of the proportional length of the Comparison of values between Taxa of the Proportional Length of the Metacarpus Relative to the Radius

Table 24.3. Comparison of Group Means via Student’s t-test

Abs(Dif)-LSD	E.h. onager	E. prz	Umm burial	Mules	E. africanus	E. asinus
<i>E.h. onager</i>	-1.2840	0.5698	0.4605	1.5606	1.6186	3.5638
<i>E. prz</i>	0.5698	-1.1120	-1.2356	-0.1434	-0.0905	1.8809
Umm burial	0.4605	-1.2356	-1.5347	-0.4234	-0.3577	1.5508
Mules	1.5606	-0.1434	-0.4234	-1.8158	-1.7419	0.1288
<i>E. africanus</i>	1.6186	-0.0905	-0.3577	-1.7419	-2.0302	-0.1856
<i>E. asinus</i>	3.5638	1.8809	1.5508	0.1288	-0.1856	-1.1409

Positive values show pairs of means that are significantly different at $\alpha = 0.05$, $t = 1.97591$.

One of the more well-known proportional distinctions among the equids is between the GL of the radius and metacarpus bones; the metacarpus bones of hemiones are longer relative to their radius bones than are those of asses (Boessneck 1976; Clutton-Brock 1986; von den Driesch & Amberger 1981; Eisenmann 1995, 8), horses (Willoughby 1974, 436, table 32). The largest differences are between asses and hemiones. Boessneck (1976) had asserted that the greatest length of the metacarpus bones would always be less than 70% the greatest length of the radius for asses, and always more than 70% for hemiones. According to [Figure 24.3](#), such precise discrimination is unfounded. The union of the ranges for individual donkeys and hemiones is quite large: 64.1–71.3%. This indicates that a simple formula cannot be used to discriminate *individuals*. However, the axiom does hold true for *population means* of asses (<70%) and hemiones (>70%). The largest mean for this ratio among published measurements for modern domestic ass is 67.2% for 27 animals in Willoughby (1974, 436, table 32), which compares well to 66.7% for 31 animals in Eisenmann (2007a,b). Six archaeological ‘donkeys’ from Tell Brak averaged 65.8% (after Clutton-Brock 1989; Clutton-Brock & Davies 1993), well under the 70% population maximum. The mean for 12 *E. africanus* individuals in Eisenmann (2007c,d) was slightly greater at 68.0%. Of all of the hemione taxa whose measurements are recorded in Eisenmann and Mashkour (2000), the Persian onager have the lowest population mean at 71.3%. This mean, as well as the highest ass-population mean (68.0%), are plotted as horizontal lines on [Figure 24.3](#) and demonstrate the clear separation *at the population level* of those taxa.

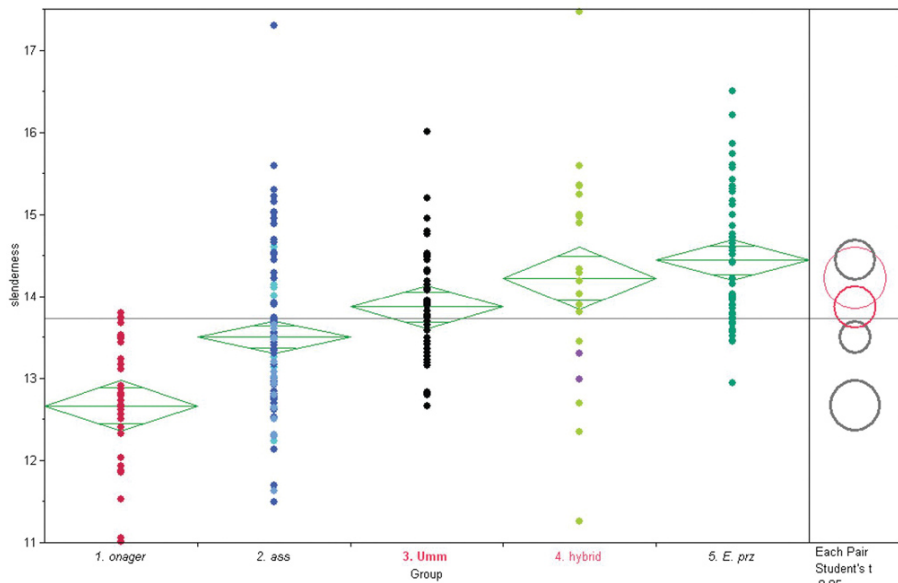


Fig. 24.4. Slenderness in the metacarpus.

Populations of Przewalski's horse have a mean value for this ratio that falls midway between the asses and hemiones; a mean of 69.5% (65.2–73.7%) was derived from measurements of 40 individuals published by Eisenmann (2013a,b), while Willoughby (1974, 436, table 32) reported a mean of 69.6%² for 13 individuals. The 68.1% mean for a sample (n=15) of *E. caballus* × *E. asinus* mules (Eisenmann 2007e,f) falls midway between populations of horse and ass, suggesting that hybrids variously draw from both parents in this trait. The mean for 21 individuals from Umm el-Marra's burial complex is 69.5% with a range of 64.0–73.9%. This is a near match to the Przewalski's horse in both mean and range. Moreover, the Umm el-Marra animals (and Przewalski's horse) fall almost exactly midway between asses and half-asses in expression of this ratio, as is indicated by the black horizontal line representing the Umm el-Marra mean, and which falls between the ass and hemione blocks. Comparing group means at a 95% level of confidence ($\alpha = 0.05$) (Table 24.3) shows that the domestic ass population is significantly different from all non-ass taxa and the onagers are significantly different from all other non-hemione taxa. However, przewalski's horse, the mules, the wild asses, and the Umm el-Marra population are *not* significantly different from each other. Overall, donkeys, onagers, Przewalski's horses, mules, and individuals from Umm el-Marra's burial population all overlap within the range 65.2–71.3% making most individual identifications based upon this proportion untenable. These ratios fall

into three groups with relatively clear hemione and domestic ass values, but a third group with horses, mules and the Umm el-Marra burial population that are internally less distinctive.

For other limb-bone greatest lengths, Umm el-Marra's burial population has the shortest radius relative to humerus, but the longest tibia relative to other long bones. For example, the burial individuals have, on average, tibia GL nearly 98% of their femur GL.

Individual element proportions

Shape is another characteristic aspect of bones, and indices meant to express shape are used to distinguish between equid taxa. One of the best known of these is the 'slenderness index', which expresses the ratio of the mid-shaft breadth to the greatest length of metapodial bones. Typically, half asses have the slenderest metapodials relative to horses and asses, while horses have the thickest (Eisenmann 1986, ; Hilzheimer 1941; Stehlin & Graziosi 1935). This is demonstrated for the metacarpus and metatarsus bones in [Figures 24.4 and 24.5](#) respectively. The slenderness is plotted by taxon, and the green 'means diamond' marks the mean (the largest breadth of the diamond) and 95% confidence interval (the upper and lower horizontal lines) for each population examined. The solid, black horizontal line marks the overall mean for all groups. The grey and red circles on the right side replicate the mean's diamond and show group similarity via 95% confidence: circles that do not overlap show means of significant difference.

For each mean tested, the red circles indicate means that are *not* significantly different. In each case, the means diamond for the Persian onager lies below the overall average indicating its greater slenderness, while that of Przewalski's horse lies well above indicating its greater robustness. Ass individuals are quite variable (see also Davis 1981, 308, fig. 13) but as a group they are among the more slender of the populations examined. The group means for each of these taxa indicate that they are significantly different from each other at a 95% level of confidence. The hybrids³ are similarly variable individually, though their group mean places them among the more robust; they are *not* significantly different from the horses. The results for the Umm el-Marra burial population differ by element. For the metacarpus bone, its mean lies quite close to the overall group mean, and the confidence interval overlaps it – placing the burial population in the middle of all those examined. Comparison of means shows that it is significantly different from the hemione, ass, and horse populations, but *not* from the hybrids. For the metatarsus bone, the Umm el-Marra burial population lies further from the group average

and is relatively more robust. The population is significantly different from the hemionines and asses, but *not* from the horses or hybrids.

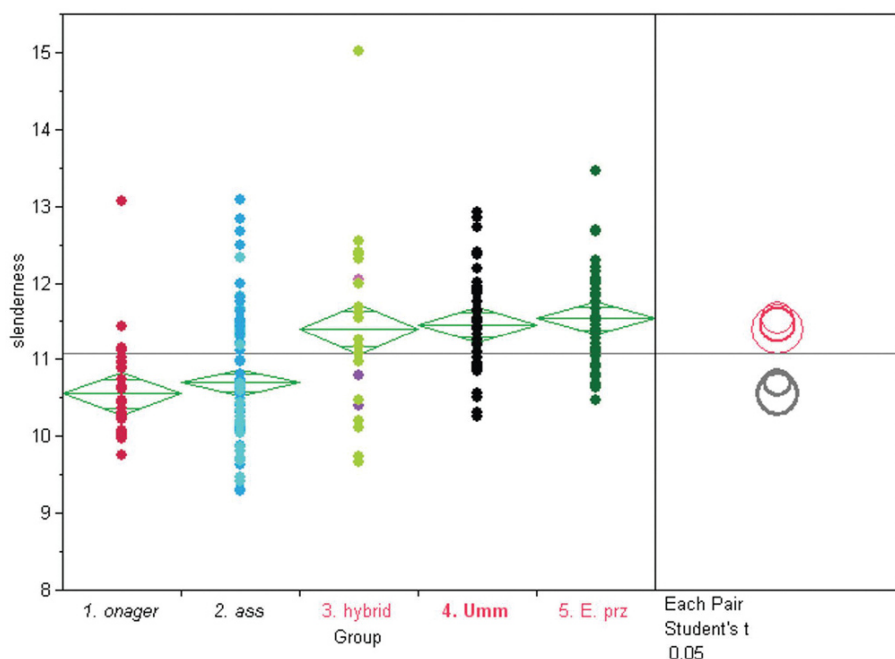


Fig. 24.5. *Slenderness in the metatarsus.*

Intra-population variation

One of the major problems in examining ancient animal populations is the difficulty with measuring their intragroup variability due to their typically small numbers of complete elements or skeletons. If the extent of individual variation is unknown, classification is made more difficult and inter-group comparisons lack statistical weight. Umm el-Marra's burial population is both numerous and relatively complete, enabling assessment of its coherence through the coefficient of variation (standard deviation $\times$ mean, 'V' in Table 24.2). For the measurements of greatest length and proportion summarised above, the coefficient of variation ranges from 2.37 to 5.46. This is low – even relative to the other equine taxa. Values between 4 and 10 are considered standard for variability contained within a single population; numbers below four suggest that the entire range of variability is not present within the population being tested while numbers above ten indicate the likelihood of individuals from more than one population (Simpson *et al.* 1960, 91). The low V might indicate that the complete range of variation is not present for all of

the measured traits of the burial population. The animals are all males, which may provide a source of constraint in the data, but the general lack of sexual dimorphism in size in equids (MacFadden 1992, 295) makes this less likely. Instead, it may be that equines have lower intra-group variation in limb lengths and skeletal proportion. [Table 24.2](#) shows similarly low values for the ‘wild’ onagers, asses, and horses – despite the fact that many of these are zoo specimens and/or stem from different breeding populations (cf Dive & Eisenmann 1991, 284). It is only the domestic asses and the mules that show variations indicative of population non-homogeneity. This should be expected given the inclusion of donkeys bred to specific size, of mule offspring having donkey and horse mares, and of wide distribution in their geographic origins.

Regardless, the low coefficients of variation for the Umm el-Marra burial population – especially in comparison to the ‘wild’ taxa – indicate the appropriateness of treating it as a homogeneous population for purposes of taxonomic comparison and classification.

Discriminant analysis

The above discussion indicates that while all equids have very similar limb proportions, there are statistically significant characteristic differences that might help discriminate between taxa. When individual elements or traits of slenderness and proportion are compared, the Umm el-Marra population does not fit neatly into any of the other taxonomic groups, but rather shares a few traits with each population. Discriminant analysis is a way to quantify unique or variable features in order to characterise different classes or taxa (cf Albrecht 1980, 681). Using the resulting classes, attributes of individuals of unknown identity can be assessed and their group affinity predicted. Analysis of the Umm el-Marra material has been criticised to date for *not* incorporating multivariate methods for comparing with, and discriminating from, known equid taxa. This is a valid critique that has resulted in the commencement of such research. I report here on its very earliest results.

Table 24.4. Actual and predicted classes using discriminant analysis with eight variables

<i>Actual class</i>	<i>Predicted class</i>			<i>% correct</i>
	E. asinus	E. prz	E. h. onager	
<i>E. asinus</i>	24	1	1	86
<i>E. prz</i>	0	32	0	91
<i>E. h. onager</i>	2	0	24	89
Mules	1	1	2	71

Table 24.5. Actual and predicted classes using discriminant analysis with five variables

<i>Actual class</i>	<i>Predicted class</i>			<i>% correct</i>
	E. asinus	E. prz	E. h. onager	
<i>E. asinus</i>	28	1	1	90
<i>E. prz</i>	0	31	1	89
<i>E. h. onager</i>	2	0	24	86
Mules	2	3	2	50
Umm burial	2	4	5	

To begin, I have used the simple measures of greatest length and slenderness from known groups of *E. przewalski*, *E. h. onager*, *E. asinus*, and mules. Correlation between these different variables was assessed using step-wise variable selection to create maximum distance between groups and thus the greatest predictive potential. The greatest lengths of the femur, humerus, tibia, radius, metacarpus, and the anterior proximal phalange, along with the slenderness of the metacarpus and the ratio of its GL to that of the radius proved to yield maximum distance, and the grouped variables successfully predicted class in 92 of 106 (87%) of the known cases examined (Table 24.4). However, because only seven of the Umm el-Marra skeletons have complete information for all of those variables, I eliminated the femur, humerus and tibia from the tests increasing the number of usable skeletons from the burial population to 19. Excluding these variables resulted in only a slight decrease (83%) in predictive success of the known taxa, chiefly among the mules (Table 24.5). The 19 individuals from the burial complex were not consistently predicted to be of any of the known groups. Despite their low intra-population variation, individuals were predicted into each of the groups to varying degrees (Table 24.5).

The largest proportion (42%) was predicted to be mules, followed by onagers, przewalski's horses, and domestic asses. In essence, there

is no common class into which the Umm el-Marra equids are predicted to reside. By contrast, all six of the ‘donkey’ skeletons from Tell Brak were predicted to be *E. asinus*. If the burial equids are assessed as their own class using the same variables, a greater percentage of misclassification results (24%); the burial population had the lowest proportion of ‘correct’ predictions at 68%, but all groups experienced a small percentage decrease as some individuals were “reassigned” to the burial group (Table 24.6).

Preliminary multivariate testing suggests that discriminant analysis is promising for classificatory exploration of the Umm el-Marra material (Fig. 24.6). That population did not fit well into any single group other than its own. However, interpretations of the results have not been fully explored and further testing involving variables of dimensions other than length, and the inclusion of other bones or teeth may add to canonical distances in order to create stronger, unique classes. In particular, there is a whole range of distinctive morphological characteristics whose quantification could prove useful in creating class attributes for discriminant analysis.

Table 24.6. Actual and predicted classes using discriminant analysis with 5 variables, including the burial population as a known class

Actual class	Predicted class					% correct
	<i>E. asinus</i>	<i>E. prz</i>	<i>E. h. onager</i>	<i>Mules</i>	<i>Umm burial</i>	
<i>E. asinus</i>	27	1	1	1	1	87
<i>E. prz</i>	0	30	0	3	2	86
<i>E. h. onager</i>	2	0	20	1	5	71
<i>Mules</i>	1	3	2	6	2	43
<i>Umm burial</i>	1	1	1	3	13	68

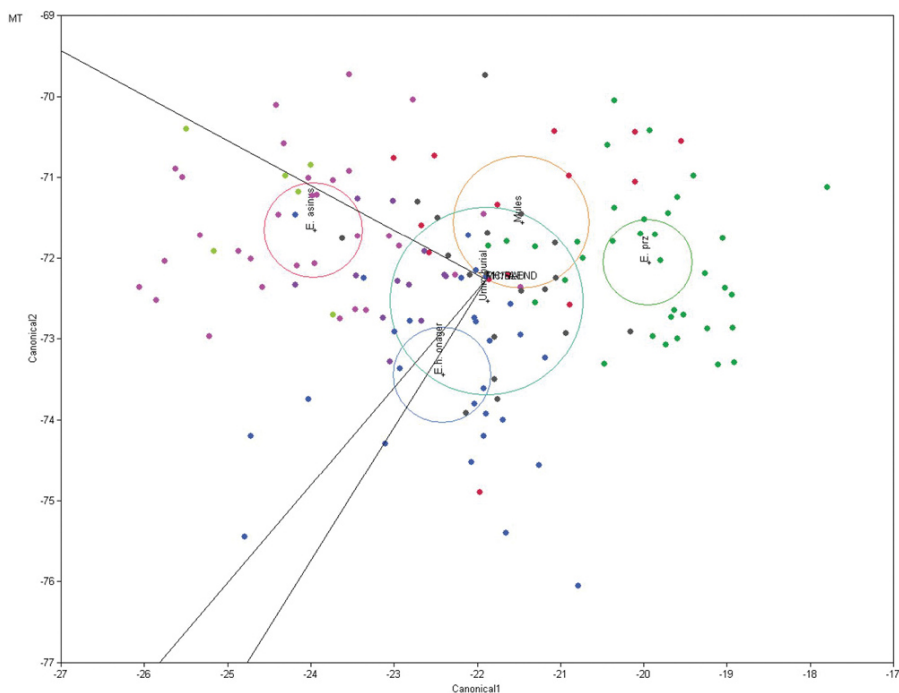


Fig. 24.6. Canocical analysis of mateatrasal.

Morphology

Morphological analysis of the Umm el-Marra burial population continues; a summary of a few pertinent traits can be found in the ASWA 8 proceedings (Weber 2008).

Dentition

Teeth of all taxa are quite varied at an intra-population level. Tooth traits are not definitive, but are suggestive particularly as a means to characterise a population (cf Eisenmann 1986, 75–76; Zeder 1986). The teeth from Umm el-Marra's burial population are still being studied, but they are characterised by their diversity, lack of conformation with any known taxa, and large proportion of malocclusion. Despite great intra-population variability of most taxa, there are some generally agreed-upon traits. Caballines are characterised by maxillary teeth with well-developed *pli caballin* and long, posteriorly projecting protocones, and by mandibular teeth with u-shaped *sinus externalis* and an asymmetrical 'double knot'. Asinine maxillary teeth are characterised by weak or absent *pli caballin* and short, symmetrical protocones, while their mandibular teeth show v-shaped *sinus externalis* and symmetrical 'double knots'. There is less agreement regarding hemiones, though they typically display features

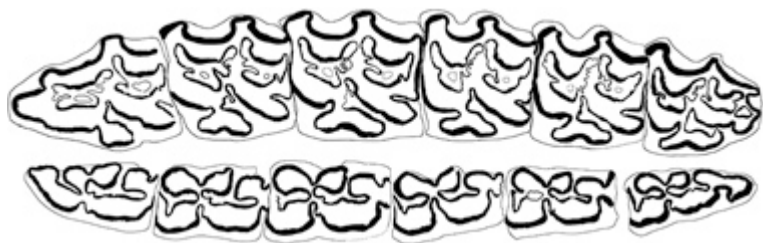
somewhere between caballine and asinine traits; they have weak or developed *pli*, asymmetrical protocones of medium-length, and rounded-v *sinus externalis*.

In these descriptive traits, the Umm el-Marra burial population does not consistently conform to any single group (Figs 24.8 & 24.9). The maxillary teeth have protocones that are variably long and asymmetrical or short and symmetrical, and *pli* are absent or poorly developed in ca. 60% of the individuals, while they are very welldeveloped in the other 40%. Those *pli*, however, intrude into a distal orientation from the mesial edge of the peninsula making them more like *pli* found in hemione teeth than in caballine teeth, which intrude lingually from buccal (Meadow & Patel 1997, 312–314). Mandibular ectoflexids (Fig. 24.7) are mainly relatively short (reaching but not penetrating the stem of the ‘double knot’) – but longer than is typical for asses – and ‘double knots’ are chiefly asymmetrical. Eisenmann (1986, 94, fig. 19; 97, fig. 27) quantified variation between taxa in the presence of isolated hypoglyphs and open post-fossettes on upper 3rd molars, and the proportion of short ectoflexids (one that does not reach the preflexid) on mandibular molars. Her findings are presented in Table 24.7, which also provides comparison to the Umm el-Marra material for the same traits.

The Umm el-Marra burial population has un-asinine proportions of upper 3rd molar open post-fossettes and ‘short’ mandibular ectoflexids, but differs from hemiones in its higher frequency of the same. While they do not substantially differ from horses in these quantitative measures, the teeth simply do not share most caballine traits.



Fig. 24.7. Ectoflexid length.



One very common feature among the Umm el-Marra animals' dentition is the presence of malocclusion – which is found in nearly 100% of the individuals. This takes several forms, including rostral hooks on either the upper or lower P2, and caudal hooks on either the upper or lower M3. These usually are opposing in the jaw – an upper rostral hook will occur with a lower caudal hook, as in [Figure 24.10](#). But, there are also cases where both caudal and rostral hooks have developed on the upper teeth. These are primary malocclusions that are generally hereditary (Nordby, *et al.* 1945; Stoddard 1947). 'Step' and 'wave' type formations on the occlusal surface – such as are shown in [Figure 24.9](#)– are secondary malocclusions that may result from primary problems.

The degree of malocclusion did not seem to impact life-expectancy – as many animals lived quite long (e.g. the ca. 20-year-old animal in [Figure 24.10](#)) – but is notable for its frequency.

Morphological characterisation and 3-D modelling

Morphological characterisation of the Umm el-Marra burial population shows a great deal of variation between individuals, and lack of conformity to any single, known taxon (for early results, see Weber 2008). Long-term morphological examination has been made possible through the creation of virtual 3-D models of most complete elements from the 30+ individuals recovered so far. Scans have been created through capture from a NextEngine 3-D Laser Scanner; an earlier 'standard' version has now been replaced with a high-definition scanner. The virtual 3-D models aid in identification of often subtle, distinctive, morphological characteristics through the capture of bone textures and topography, which can then be digitally enhanced and analysed. Importantly, they preserve all such data for future examination, improving the chance that new discoveries of morphological distinction and detail can be applied at any present or future time. These models can be cheaply and easily transferred between researchers, preserving and sharing this important database.

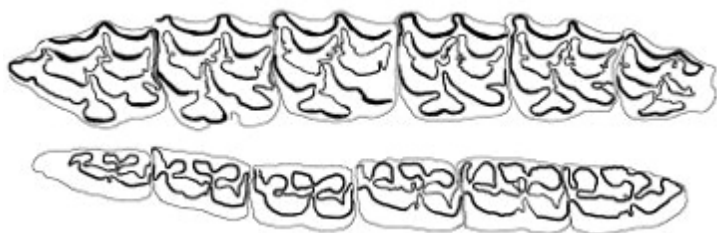


Fig. 24.9. Dentition from Individual A, Installation E.



Fig. 24.10. Dentition from A1, Installation D.

For instance, I was unaware of many of the traits useful for distinguishing between donkeys, horses and mules (see Johnstone 2004; Peters 1998) until *after* much initial work had been completed with Umm el-Marra's burial equids. But it is possible to re-examine the scanned works and assess the elements for those criteria. [Figure 24.11](#) is a model of a radius that shows torsion of the shaft, the presence and depth of the *chrsta transversa*, and the presence of a 'line' across the distal, lateral condyle (cf Uerpmann 1991).

Some degree of subjectivity can be eliminated and standardisation between researchers improved by easily documenting morphological variability without the aid of a skilled illustrator or photographer. For example, the three astragali in [Figure 24.12](#) document varying levels of protrusion by the medial tubercle (after Uerpmann 1986). [Figure 24.13](#) shows the shape and position of the muscle scars on the volar surfaces of two separate proximal, posterior phalanges ([Fig. 24.14](#)).



Fig. 24.11. Dentition from Individual C, Installation G.

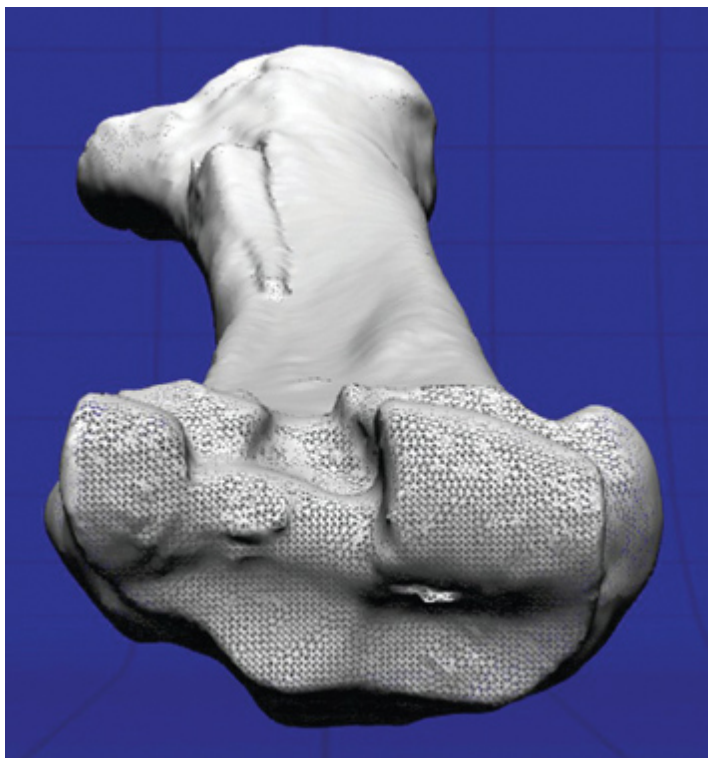


Fig. 24.12. Image of 3-D model of radius, Individual 405.

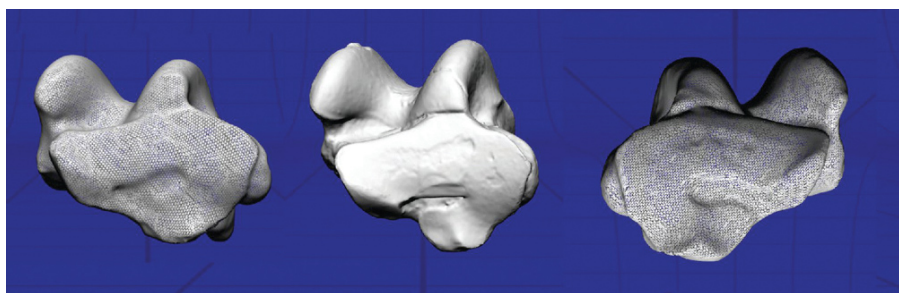


Fig. 24.13. Images of 3-D models of astragali from a. Installation A; b. Individual 405; c.

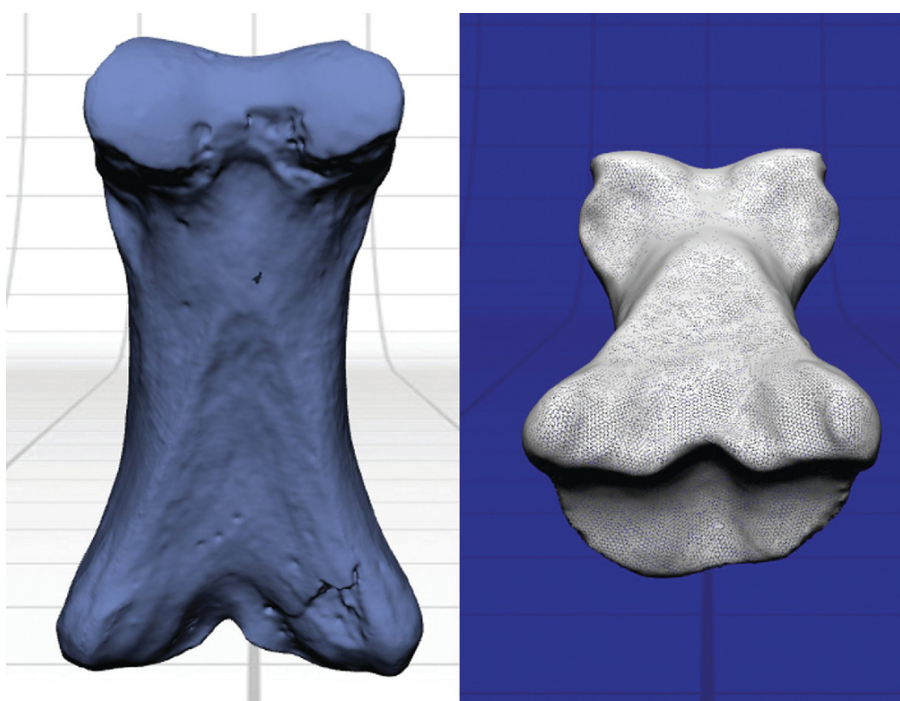


Fig. 24.14. Image of 3-D model of posterior, proximal phalanges from a. Individual 405; b. Installation A (not to same scale) Installation F (not to same scale).

Discussion

The metrical analyses shown above, while still preliminary, indicate significant differences between the Umm el-Marra burial population and known populations of ass, onager, and horse; these suggest that the burial population is not to be classified as one of those taxa. As what, then, are they to be classified?

Overall we have an animal whose height and limb bone lengths are mainly similar to those of onager, whose robusticity in the metapodiae, and relative metacarpus to radius length is reminiscent of przewalski's horse, and whose dental characteristics bear no strict relationship to any single taxon. Initial discriminant analysis also indicates that the burial population is more internally consistent than it is similar to other, known taxa. Furthermore, analysis of variation indicates that the burial individuals constitute a single, highly homogeneous population.

We know that part of the reason for that homogeneity is the extreme conformity of their demographic: they are all male, were used

for draft from a young age, were controlled/confined, shared the same environment in life and death, and were bred within a few hundred years of each other. The draft status of the animals also suggests that the animals were under human control, and thus were domestic – or at least tamed.

A domestic status for the Umm el-Marra population seems to stand in contrast to the low variation (V) expressed in measures of long-bone length and robusticity. As a result of domestication, itself, ‘total variation increases in almost every respect including animal size and proportions ...’ (Boessneck & von den Driesch 1978, 26). Artificially maintained, captive, domestic populations typically have greater genetic variability due to the removal of natural barriers and more ‘relaxed’ selection (Price 2002, 74). But, traits that have explicit selection have lower total variation, while those with low selection have much higher variation (Simpson 1944, 83). The majority of the metric traits examined are phenotypic expressions of height and proportion that could be targeted in selection and which are largely independent of activity. On the other hand, there is much greater (apparent) variation in the expression of non-metric morphological traits of the individual bones and dentition. Such traits may not have experienced explicit selection – whether because they had no outwardly-visible phenotypic expression or were not considered important, resulting in much greater intra-population variation. Dental malocclusion, however, is a visible phenotypic trait that is hardly considered beneficial in animal breeding, but which is very frequent in the Umm el-Marra burial population.

The totality of these features – a single population that does not conform to populations of ass, hemione, or horse, with very low variation in size, high variation in non-metric traits, and a large degree of dental malocclusion – supports their identification as hybrids, and as ancient *kunga*. In the wild, ‘natural’ hybrids are characterised by increased trait variation that is typically expressed as ‘non-metric anomalies’ (Ackerman *et al.* 2006, 642). Hybrid trait variability often exceeds that of its parent populations, does not always reflect equal influence by both, and can result in innovative traits not found in either parent (Ackerman *et al.* 2006, 642). Darwin (1900, 16–17) had already observed such trends in equid hybrids and, more recently, Eisenmann and Bekouche (1986, 124, 126–127) noted variability in the degree to which hybrid offspring resembled one or both parents in their morphology. Significantly, dental abnormalities and anomalies are quite common features of interspecific hybrids (Ackerman *et al.* 2006, 641; Goodwin 1998; Mengel 1971).

The cultural context of the skeletons – buried in the midst of an elite cemetery – already suggests that these were elite animals. Their high-status and their specific demographic as large-sized, all male, draft animals specifically links them to the ancient *kunga* (Weber 2008).

Size was an important feature of the ancient *kunga*, which were grouped into ‘female’, ‘male’ and ‘superior male’ categories (Zarins 1976, 450–461). It was the latter group of large-sized males that were specifically selected for use by royalty in pulling their wheeled vehicles.

The extreme conformity in height (greatest lengths) displayed by the burial population suggests that this was a phenotype that was specifically selected, adding further support to its identification as the *kunga*.

The most parsimonious explanation for the data currently available is that the Umm el-Marra burial population is composed of hybrid animals. Their cultural context and demography equate these animals to the ancient *kunga*, often considered to be a hybrid of ass and onager parentage

(Archi 1998, 9, n. 48; Heimpel 1994; 1995, 89–91; Postgate 1986; Zarins 1986, *contra* Maekawa 1979; 2006). I suggest that classification is correct, and that the burial population considered here is, in fact, a population of ass and onager hybrids.

Notes

1 Installation F is the entity formerly referred to as the ‘Stone Platform’ (Weber 2008).

2 A range was not published by Willoughby.

3 The ‘hybrids’ group includes two, non-traditional hybrids: a hemione × horse cross and a hemione × ass cross, measurements from Eisenmann (2007g,h).

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25. An unusual cattle burial at Dayr al-Barshā (Late Period, Middle Egypt)

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During excavations in the desert plain near Dayr al-Barshā in Middle Egypt, a circular pit filled with cattle bones was found. The pit, with a diameter of about 1.5m, contained the almost complete skeletons of 15 Egyptian Longhorns, dated to 410–360 cal BC. The material was in a remarkably good state of preservation, but few elements were found in articulation. Apart from the more-or-less complete skeletons, some fragmentary remains of at least three additional individuals have been collected. The age at death, sex and size of the animals has been established and the pathologies and traces on the bones have been recorded. No parallels are known for the cattle burial at Dayr al-Barshā. The animals were probably kept in the context of a local temple economy. In line with common practices at that time, their bodies were macerated and the obtained skeletons ceremonially buried later on.

Keywords cattle, burial, ritual, maceration, Herodotus

Introduction

Dayr al-Barshā is an archaeological site in the Nile Valley of Middle Egypt at about 300km south of Cairo (Fig. 25.1). Its main features are cemeteries and limestone quarries. Since 2002, the Katholieke Universiteit Leuven (KU Leuven) has been conducting archaeological fieldwork at the site, concentrating on its cemeteries (Willems *et al.* 2004). One of the principal research aims is to understand the spatial organisation of the cemeteries, which mainly date to the Old Kingdom, the First Intermediate Period, and the Middle Kingdom. In this way, it is hoped to obtain a clearer understanding of the social

stratification of the community buried there, at least insofar as this reflects itself in burial practices. In 2006, excavations were started in the cemeteries in zone 9B at Dayr al-Barshā, which is part of the desert plain. That year, cattle bones were noted in one of the trench walls (Sector 120). When the trench was enlarged to investigate the nature of these cattle bones, it appeared that they were part of a large concentration. As the excavation season was coming to an end, and since no faunal specialist was present at the site at that time, it was decided to postpone further excavation of this feature to the following season. In 2007, the first and last authors of this contribution carried out the excavation of this locus.

The cattle bone concentration turned out to be deposited in a circular pit with a diameter of about 1.5m. At the time this pit was dug, the top of the shaft of an older grave was cut through. A few potsherds and some human remains were found mixed with the cattle bones. The cattle pit was divided in four quadrants and was emptied by removing the bones by artificial layers and by quadrant. Before a new layer was taken out, a picture was taken, on which the bones that were subsequently removed were indicated. Isolated long-bones or articulating long-bones were bagged separately while all miscellaneous bones, ribs, vertebrae, phalanges etc., were placed together in one find bag. The skulls were numbered, and all bones clearly associated with them were given the same number. Apart from standard sieving of all sediment on 4mm meshes, several soil samples were taken for archaeobotanical analyses during the excavations. Besides cattle bones, the pit contained very few other finds. There were some pieces of textile, and some textile imprints, which have not been analysed yet. A few potsherds were also associated with the pit. These were tentatively dated to the end of the New Kingdom, and the beginning of the Third Intermediate period, which corresponds to around 1000 BC. However, the fragments were small and much eroded, and ceramics of this period are hard to discern from later Third Intermediate Period ceramics (Aston 1996). Moreover the sherds may already have been lying about when the cattle pit was dug. Therefore, 1000 BC is merely to be considered a *terminus ante quem non*. In an attempt to date the deposit more securely, a cattle bone was submitted for radiocarbon dating. The obtained date of 2140 ± 40 BP or 410–360 cal BC (two sigma calibrated) is significantly younger than expected. No archaeological traces of similar age have been found up to now in the cemeteries at Dayr al-Barshā, but it was a period of large scale exploitation of the stone quarries, under the reign of pharaohs Nectanebo I and II (Willems *et al.* 2004; 2006; 2009;

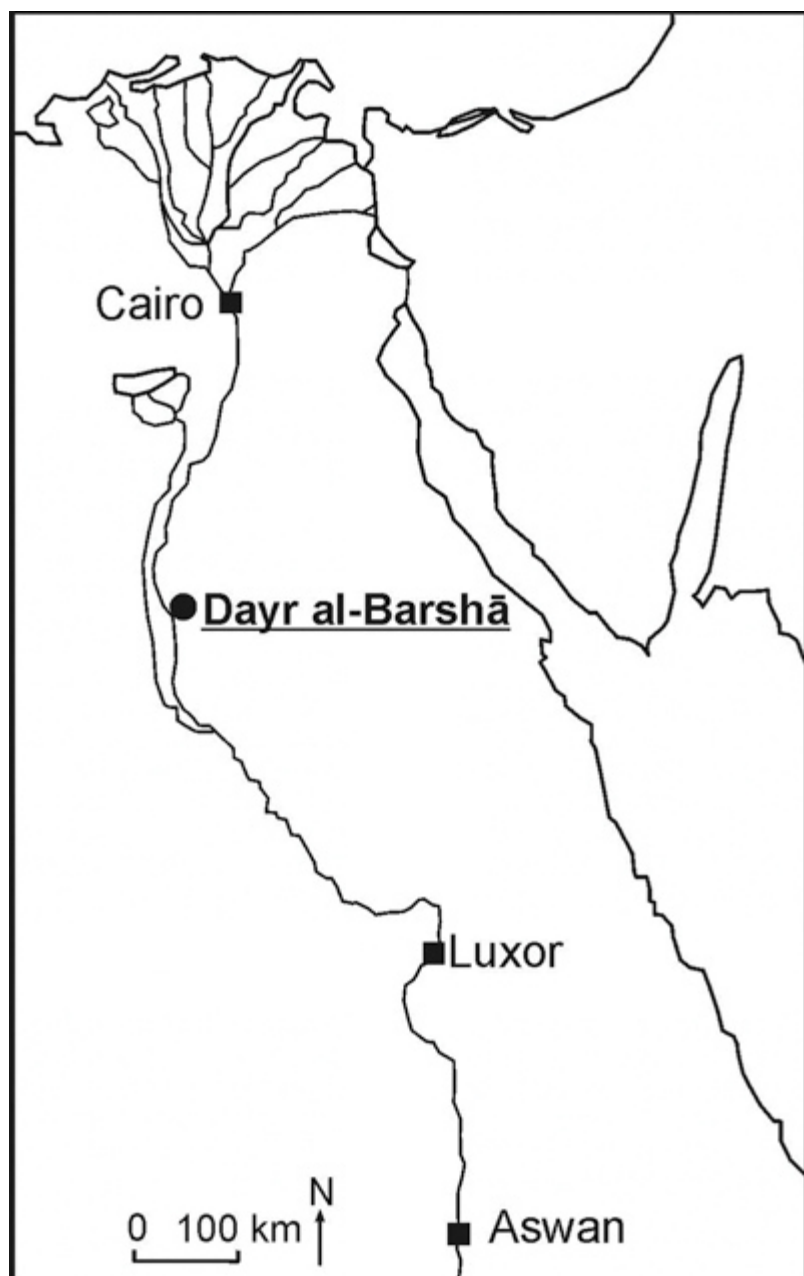


Fig. 25.1. Map of Egypt with location of Dayr al-Barshā.



Fig. 25.2. The concentration of cattle bones at Dayr al-Barshā halfway through its excavation.

Description of the bone remains

Minimum number of individuals and state of preservation

The faunal analyses have shown that the pit at Dayr al-Barshā contained the remains of 15 more-or-less complete cattle individuals. Although some articulating joints occur, most of the material was found disarticulated. Based on their horn shape and size (see below), the animals were identified as Egyptian Longhorns, the most common cattle type of ancient Egypt (Boessneck 1988, 69). The material is in an excellent state of preservation, often with hooves, horns, hair and sometimes even skin and tendons still adhering to the bones. Because of this exceptional state of preservation, the hair colour of the animals could also be observed. On the skulls dark-brown hair, sometimes with paler spots indicating piebald animals, as well as reddish hair is present. These colours correspond with the ones that can be seen in the iconography, for example in the three wooden models from the Middle Kingdom tomb of Meketre at Thebes that represent the management and slaughter of cattle (Gilbert 1988). The skulls of the animals, sometimes in association with the corresponding mandibles, hyoid bones or first cervical vertebrae, seemed to be approximately arranged along the western, southern and eastern edge of the pit (Fig. 25.2). With the exception of skull 2, all skulls were roughly facing east. The other bones were placed in the pit without any visible logic.

The skeletons are apparently not entirely complete, since for most skeletal elements a few specimens are missing (Table 25.1). In addition to the 15 well-preserved animals, there are fragmentary postcranial remains of at least three other cattle individuals. These remains differ from the other material by their black colour and more fragile nature. The blackish bones occurred in concentrations in the pit, and were especially numerous at the bottom. This is also where other faunal remains and the aforementioned pot sherds were found. The faunal elements have the same appearance as the additional cattle bones and include a fragment of a large freshwater bivalve, an equid distal metapodial (attributed to donkey because of its small size), a dog or jackal first phalanx, an ovicaprine lower third molar and distal humerus were also recorded at the bottom of the pit. The colour of the blackish remains is due to the sediment adhering to them. Analysis of its composition (30% clay, 45% silt and 25% sand) has shown that it is loam-clay loam (Bert Duser pers. comm.). This type of sediment is characteristic for the alluvial plain and is not present naturally in zone 9B near Dayr al-Barshā. The plant remains found inside this sediment are in agreement with such an origin, since they are all from sedges (Cyperaceae), associated with wet places like marshes, swamps, muddy river banks or wet sand dunes (Elena Marinova pers. comm.).

Table 25.1. Fusion data for the long-bones of the complete cattle found at Dayr al-Barshā, with in the right column the elements that are missing to arrive at 15 complete skeletons

Element	Age of fusion (Silver 1963)	left			right			left or right			Missing bones
		NF	fus	F	NF	fus	F	NF	fus	F	
Distal humerus	12–18 months	2	1	12	2	2	11				
Proximal radius	12–18 months	1	–	14	1	–	13				1 right radius
Phalanx 1	18 months							8	–	95	37 phalanges 1
Phalanx 2	18 months							5	3	99	33 phalanges 2
Distal metacarpal	24–30 months	3	–	12	2	–	12				1 right metacarpal
Distal tibia	24–30 months	2+1?	2	10	2	2	11				1 left tibia
Distal metatarsal	37–36 months	3	–	12	3	–	12				
Calcaneus	36–42 months	4	4	5	4	4	7				2 left calcanei
Proximal femur	42 months	4	9	1	4	9	1				1 left, 1 right femur
Proximal humerus	42–48 months	5	9	1	5	9	1				
Distal radius	42–48 months	2	8	5	3	5	6				1 right radius
Proximal ulna	42–48 months	11	–	4	9	1	4				1 right ulna
Distal femur	42–48 months	4	8	2	4	7	3				1 left, 1 right femur
Proximal tibia	42–48 months	7	6	1	7	6	2				1 left tibia

NF = Not Fused, fus = fusing, F = Fused

Age at death

Several criteria were used to estimate the age at death of the animals. First of all the eruption of the mandibular teeth was recorded. One animal has the 1st molar erupting, another one the 2nd molar, still another one the 3rd molar, whereas all the others have all their

permanent teeth in place. Great variation in tooth eruption dates have been observed depending on breed, management and nutrition (Silver 1963). The better the housing and feeding of the animals, the earlier the teeth erupt. Since ancient Egyptian cattle were usually well taken care off, it is supposed that the ages for early maturing cattle may apply better to the Dayr al-Barshā specimens. For such animals an age of 0.5 years is accepted for the 1st molar to erupt, of 1.5 years for the 2nd molar, and of 2–2.5 years for the 3rd molar (Silver 1963). Once all teeth have erupted, tooth wear is used to determine (relative) age. A summary of the Grant (1982) wear stages of the mandibular teeth shows that all cheek teeth rows have moderate to rather heavy wear (Table 25.2).

Like the tooth eruption data, the fusion stages for the long bones point to the presence of three animals under the age of 2 or 2.5 years (Silver 1963) (Table 25.1). It appears that many of the sutures that close after 2 or 2.5 years of age are in the process of fusing. A striking observation is that fusion stages are different in several cases between the left and right side of the same skeletal element. It seems that only two or three individuals have epiphyseal sutures fused that usually close around the age of 4 years. Also the skull suture data point to only two individuals over the age of 3 years or older. Skull 9 is of an animal of at most 7 years of age, skull 13 is of an individual of maximum 10 years of age (Table 25.3). According to Habermehl (1975, 103) the ossification of the pubic symphysis takes place at an age of 3–5 years, although he adds that in some individuals ossification has not happened yet at the age of 7 years. None of the cattle from Dayr al-Barshā has its two pelvic halves fused. Fusion data of vertebrae have not been recorded, because of the inconsistencies that are frequently noted in these elements, often with different fusion states between the cranial and caudal side of the same vertebra. Another ageing method for cattle uses the number of growth rings visible on the horn sheath (Habermehl 1975, 85–86). Such rings are thought to be formed as a consequence of a seasonal change or a slowing down in the growth rate of domestic cattle. The actual age of the animals would then be the number of rings, plus two in late mature breeds, and plus one, in early mature breeds (Habermehl 1975, 89). The method has been applied by Chaix (2001) to determine the age of bucrania from Kerma in Soudan (Middle Kerma, ca. 2050–1750 BC). Growth rings are very difficult to distinguish on the horn sheaths of the cattle from Dayr al-Barshā. Most of them have about three or four such rings, while in skull 10 and skull 13, there may be up to ten. Only for skull 13, suture data had already indicated a

relatively old age.

Table 25.2. Tooth wear stages and eruption stage of the cement-enamel-junction (CEJ) for all mandibles from Dayr al-Barshā. Only the left mandible was recorded when both sides were found associated.

Number	Side	Remark	Wear stages ¹				
			dP4	P4	M1	M2	M3
AE4-AG8-AG18	L and R	with skull 15	e		E		
R5	L	with skull 1	h		c	V	
I2	R	with skull 1 and mand R5	h		c	E	
T7	L	with skull 14 and mand X3	k		l	j	1/2
X3	R	with skull 14 and mand T7	k		k	g	1/2
L3	L	with R4?		c	k	j	g
AG3	L and R			d	l	k	g
R4	R	with L3?		d	k	j	g
Skull 9	L and R			g	l	k	k
AC10	L			g	j	h	j
AG5	L			g	k	k	j
H1	L	with M3?		g	l	k	j
M12	L			g	o	l	k
AG17	L and R			g	l	k	k
M3	R	with H1?		g	k	k	h
P10	R			g	k	k	g
Skull 2	L and R			h	m	k	k
AC6	L	with Q5?		h	abn	m	k
Skull 13	R			h	p	k	l
K5	L and R			j	abn	e	k
AC9	L and R			j	abn	l	k
Skull 12	R			j	n	l	j
Q5	R	with AC6?			abn	l	j

¹Grant (1982); abn = abnormal

Table 25.3. Fusion data for the skulls of the complete cattle found at Dayr al-Barshā.

<i>Skull suture</i>	<i>Age of fusion (Grigson 1982)</i>	<i>Skull number</i>													
		2	3	4	5	6	7	8	9	10	11	12	13	14	
Basisphenoid-basioccipital	2–3 years	NF	NF	F	fus	F	NF	fus	F	F	NF	NF	F	NF	
Temporale-parietale	5–7 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	F	NF	
Parietale-frontale	5–7 years	NF	NF	NF	NF	NF	NF	NF	fus	NF	NF	NF	F	NF	
Lacrimale-frontale (in orbit)	7–10 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	F	NF	
Frontal halves	7–9 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	–	NF	
Zygomatic processes of squamosal and jugal	10–15 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	
Maxilla-jugal	10–15 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	
Maxilla halves	15–40 years	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

NF = Not Fused, fus = fusing, F = Fused

In summary, three out of the 15 complete cattle were younger than

2.5 years, namely 0.5, 1.5 and 2–2.5 years respectively. For the cattle older than that, the different types of data are not always consistent. Depending on the method used, a total is obtained of two or up to four individuals that are ‘old’, i.e. of an age over about 4 years. It is clear, however, that the majority of the individuals are prime adults. For the three additional, incomplete cattle only long-bone, fusion data can be used for age determinations. Since all epiphyses are fused the animals must have been at least 3.5–4 years.

Sex and height at the withers

For the sex identification both metrical data and morphological criteria can be used. The pelvic bones of the complete, adult animals from Dayr al-Barshā are male in shape, i.e. with a sturdy overall build and strong pubic branches. Some of the specimens seemed more slender and gracile, which would be indicative of castrated animals, but it was generally not easy to decide on the pelvis whether they are from oxen or bulls. The method of Greenfield (2006), designed mainly to sex fragmentary ungulate acetabulae, was also tried on the pelvic bones of Dayr al-Barshā, but the results were inconclusive. The method relies much on the height of the medial wall of the acetabulum (H1) (see [Table 25.7](#) below). Greenfield (2006) himself has noted a problem with this measurement. A variable morphological feature appears in the female of some taxa, including cattle, with the medial wall of the acetabulum characterized by a dip or depression in the centre. This renders it more difficult to measure the height of the acetabular wall and the measurement thus includes the dip. All of the pelvic bones from Dayr al-Barshā show this dip in the acetabular wall, even though their overall shape is male.

Other criteria for the sexing of cattle confirm the conclusions made on the basis of the shape of the pelvic bones from the complete skeletons from Dayr al-Barshā. Breadth measurements on the skulls, which allow separating skulls of bulls from those of cows of the same breed (Grigson 1982), do not indicate more than one group. They seem to fit best with the few published male and castrated Egyptian Longhorn cattle (Lortet & Gaillard 1903; Boessneck & von den Driesch 1987a) from the literature, rather than with the females (Jackson 1934). Grigson (1976) described a few non-metrical sexual differences in skulls of cattle. The intercornual ridge projects more strongly upwards in bulls than in cows and the supraorbital groove is deeper and longer, which tends to roof over earlier in bulls. The ring of nodules at the horn core base, which characterises old animals, develops earlier in bulls and so does the occipital flange. No such differences have been clearly noted between the individuals of Dayr

al-Barshā. They all rather show the aforementioned characteristics for bulls, although not very pronounced ([Table 25.4](#)).

According to Sykes and Symmons (2007), two measurements at the horn core base, the Basal Circumference (BC) and the Basal Breadth (BB) are the best measurements for sexing horncores, although they do not allow differentiation between males and castrated males. The measurements from Dayr al-Barshā seem to form one homogeneous group. When they are compared with the few sexed ancient Egyptian Longhorns from the literature, they plot with bulls and oxen ([Fig. 25.3](#)). Based on iconographic evidence, the horn shape of female ancient Egyptian Longhorns has been described as lyre shaped, horns of males are shorter and thicker and crescent shaped and those of oxen are particularly long, and high, but less curved than in cows (Boessneck 1988, 69; Laudien 2000, figs. 16–18). The horns from Dayr al-Barshā do not seem to fit either of these descriptions perfectly. They are approximately crescent shaped, but they are too long and too slender to be bulls. The best match is with castrates.

Among the long-bones, the metatarsals and metacarpals are best suited for sex determinations. Male and female metapodia can easily be distinguished on distal breadth, and castrates can be separated from bulls on length measurements (Grigson 1982). The greatest length (GL) and the smallest diameter of the shaft (SD), taken on metacarpals of the complete cattle skeletons from Dayr al-Barshā, fall in the range of oxen and bulls when they are plotted against sexed Egyptian cattle remains from literature ([Fig. 25.4](#)). Measurements taken on a bone of one of the three additional animals, fall in the female range. Measurements on the metatarsals from the 15 cattle from Dayr al-Barshā fit with castrates and the upper range of females from literature, but not with the only bull ([Fig. 25.5](#)). The two metatarsals from the additional animals are smaller than those of the complete skeletons and fall, like the metacarpal, within the female range. None of the other sexing methods cited can be applied on the additional cattle because their remains are not preserved well enough.

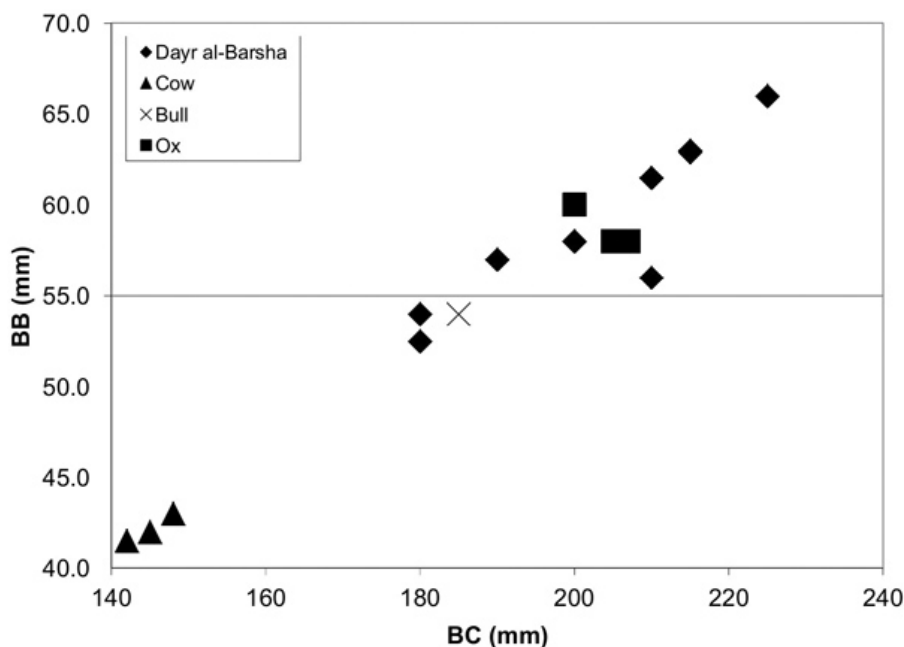


Fig. 25.3 Basal circumference (BC) and basal breadth (BB) of horn cores from cattle found at Dayr al-Barshā compared with published data. Cows and bull are from the temple at Elephantine (Boessneck & von den Driesch 1982). Oxen include the Münchner Ochsenmummie (Boessneck & von den Driesch 1987a) and two individuals from Tūna al-Jabal (Boessneck & von den Driesch 1987b).

Table 25.4. Description of cattle horns and skulls from Dayr al-Barshā

	Skull 2	Skull 3	Skull 4	Skull 5	Skull 6	Skull 7	Skull 8	Skull 9	Skull 10	Skull 11	Skull 12	Skull 13	Skull 14
Horn curve (classification Sykes & Symmons 2007)	4	3	3-4	4	3	3	2-3	3	3	3-4	3-4	3	—
Horn torsion (classification Sykes & Symmons 2007)	1	1	2	1-2	1	1	2	1-2	2	2	1	1-2	—
Left tip chopped off: yes (y), no (n)	—	n	y	n	y	n	—	n	y	y	—	y	—
Right tip chopped off: yes (y), no (n)	n	n	—	n	y	n	n	y	n	y	n	y	—
Non-measurable characters (Grigson 1976)*:													
Bone surface: slight roughening surface orbital rim (a), smooth (b)	a	a	a	a	a	b	b	a	a	a	b	a	a
'Perlen': present (y), absent or nearly absent (n)	n	n	n	n	n	n	n	n	n	n	n	n	n
Supraorbital groove (never roofed over): distinct (a), undistinct (b)	a	a	a	a	a	a	—	a	a	a	a	—	a
Occipital flange: present (y), absent (n)	y	y	y	y	y	y	y	y	y	y	y	y	y
Premaxilla touching nasal: yes (y), no (n)	y	y	y	y	y	—	y	y	y	—	n	y	y
Orbital rim: sharp (a), flat (b)	b	b	b	b	b	b	b	b	b	b	b	b	b
Suture frontale-lacrimale on face: bowed ventrally (c)	—	c	a	c	a	—	c	c	c	c	a	a	a
Suture lacrimale-jugale on face: straight (b), bowed dorsally (d), bowed ventrally (e)	—	e	e	e	e	—	d-e	e	e	e	e	e	e
Intermaxillary suture open: yes (y), no (n)	y	y	y	y	—	—	y	y	y	y	y	y	y
Posterior end palate: straight & broad (a), convex & narrow (b), straight & narrow (c)	c	c	c	a	c	c	c	c	b	b	a	b	c
Frontale profile from above: convex (a), flat (b), slight boss (c)	c	b	b	b	b	b	b	b	b	a	b	b	c
Intercornual ridge: low single arch (a), low double arch (b), high single arch (c)	d	b	b	c	b	d	b	b	b	a	b	b	b
Horncore longitudinal grooves: strong (a), moderate/weak (b), absent (c)	a	b	—	a	b	b	c	—	a	a	b	—	b
Horizontal ridges or rings on horns: estimate of number	min 3?	min 3	min 4?	0	—	2-4	—	—	max 10?	3?	—	8-10?	0

* Sagittal profiles are not described since this involves making casts of the skulls. Without reference specimens at hand, it appeared difficult deciding whether the shape of the external auditory meatus was taurine or indicine-like. The shape of the nasal-frontal suture as well as the presence of vascular channels on the horncore surface were also hard to describe precisely. These three characteristics used by Grigson (1976) have therefore not been included.

In summary, all complete, adult cattle from Dayr al-Barshā are males. Although the pelvic bones did not clearly indicate so, the animals are considered as castrates on the basis of the horn shape and the metapodial measurements. A possible additional argument for an identification as oxen are the long-bone fusion data that are very variable in the sense that the fusion stages of left and right bones of the same element differ in several cases (Table 25.1). Many bones are, moreover, in the process of fusing. Both conditions could be a result of the effect of castration on the age of closure of (long-) bone sutures (cf. Davis 2000 for sheep). The metrical data of the additional bones indicate that these are from cows.

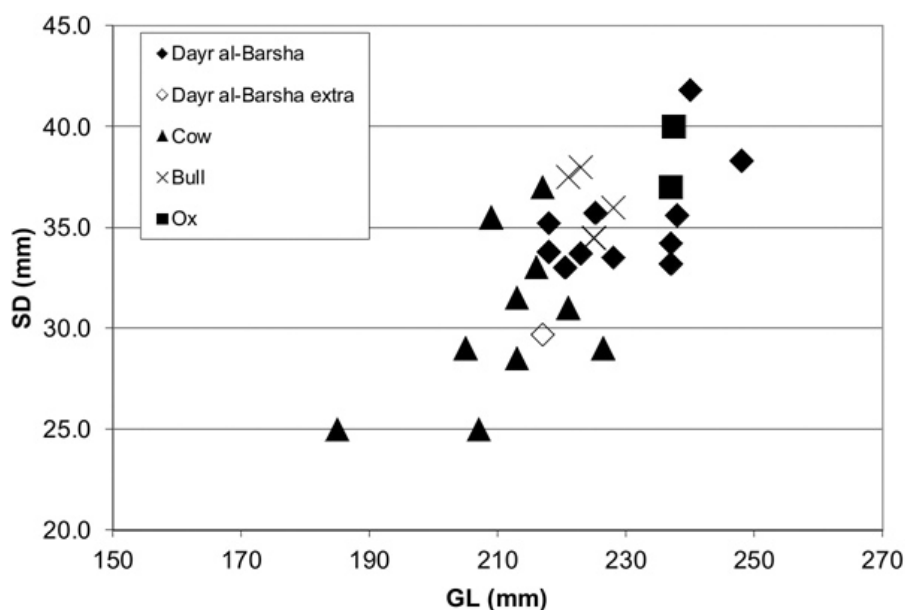


Fig. 25.4. Greatest length (GL) and smallest diameter of the shaft (SD) of right metacarpals from cattle found at Dayr al-Barshā compared with published data. Cows are from Tell el Dab'a (Boessneck & von den Driesch 1992), the temple at Elephantine (Boessneck & von den Driesch 1982), Tūna al-Jabal (Boessneck & von den Driesch 1987b) and Baqaria (Jackson 1934). Bulls are from Tell el Dab'a (Boessneck & von den Driesch 1992). Oxen include the Münchner Ochsenmummie (Boessneck & von den Driesch 1987a) and one individual from Tūna al-Jabal (Boessneck & von den Driesch 1987b).

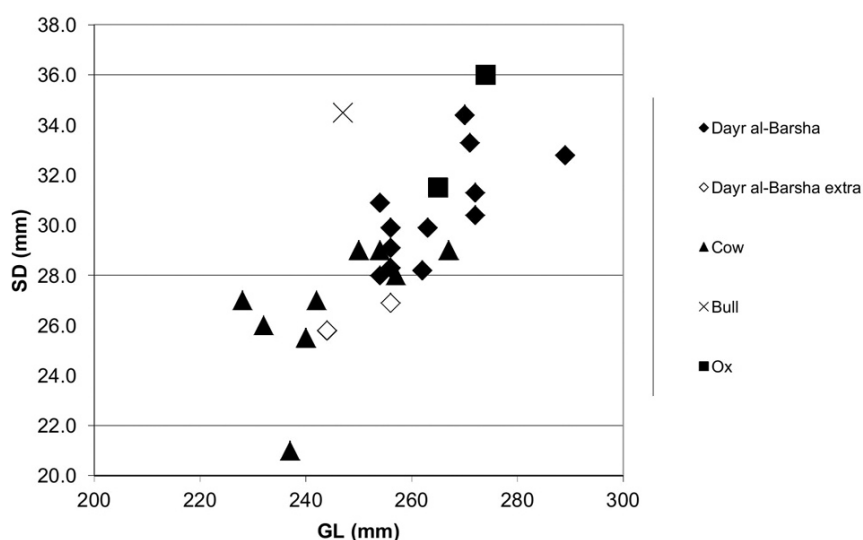


Fig. 25.5. Greatest length (GL) and smallest diameter of the shaft (SD) of

right metatarsals from cattle found at Dayr al-Barshā compared with published data. Cows and bull are from Baqaria (Jackson 1934). Oxen include the Münchner Ochsenmummie (Boessneck & von den Driesch 1987a) and one individual from Tūna al-Jabal (Boessneck & von den Driesch 1987b).

Withers height estimates were calculated from the longbones of the complete adult cattle from Dayr al-Barshā, using the factors in von den Driesch and Boessneck (1974). The results are variable according to the bone, but they all give an average of about 140cm based on the factors for castrates (Fig. 25.6). This is rather tall, but cattle of ancient Egypt apparently grew up to 150cm at the withers and taller (Boessneck 1988, 69). For the additional animals the factors for females indicate shoulder heights of 117–130cm (Fig. 25.6).

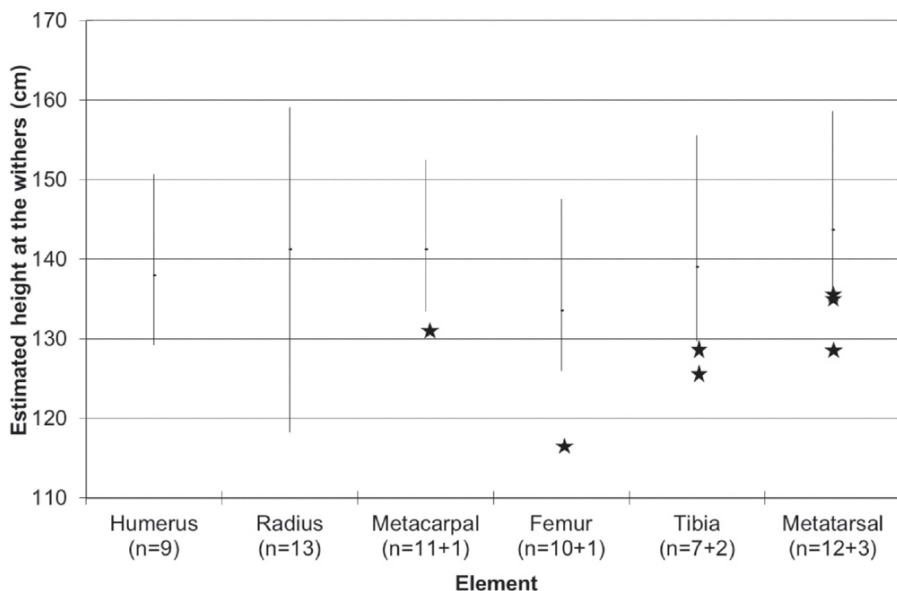


Fig. 25.6. Withers height reconstructions of the cattle found at Dayr al-Barshā. Calculations are made by multiplying the lengths of different long bones with the factors for castrates (complete animals) and females (additional animals) in von den Driesch and Boessneck (1974). Apart from a right femur of the additional animals, only left bones have been used (source measurements see Tables 25.7 & 25.8). The lines represent the range and average of the values by element for the complete animals, the stars indicate the values for the additional animals.

Pathologies and other traces

Several types of pathological deformations have been observed on the

skeletal remains from the cattle pit at Dayr al-Barshā. Two skulls show evidence of a healing puncture of the frontal bone. Skull 9 is the most obvious example. It has a hole of almost 5cm wide in the right frontal bone, where part of the skull has been pushed down (Fig. 25.7, c–d). New bone tissue was already forming at the time of death of the animal, and the wound itself was therefore probably not the cause of death. In skull 5 a puncture of about 3×1.5 cm occurs midway the left frontal bone. The nasal bone of this skull also shows abnormalities. Its cranial half is at least 12mm below the dorsal part of the premaxilla, while in normal circumstances it is level with it (Fig. 25.7, b). The right maxilla of skull 4 has an abnormally porous bone structure, and moreover shows light periodontitis (Fig. 25.7, a). Periodontitis can also be seen in skulls 7 and 10. Three mandible pairs show abnormal wear at the height of both the left and right first molar, and in one case (N9) also on adjacent parts of the P4 and M2, causing malocclusion (Fig. 25.8). On most of the tooth rows calculus has been formed, sometimes quite heavily, making observations on the eruption of the cementum-enamel-junction impossible (see above).

One right pelvic bone (U8) has an abnormal torsion at the height of the wing of its ilium, and in one sacrum (A11) the last two vertebrae are out of axis with the first three. A right metatarsal (V6) shows periostitis, midshaft on the medial side. One left (AD1) and one right (AF8) naviculocuboid from the cattle pit at Dayr al-Barshā have the 2nd and 3rd tarsal fused to it (Fig. 25.9). These can be considered as cases of spavin (Bartosiewicz *et al.* 1997, 71). Draught exploitation is in part responsible for the development of this pathology. However, deformations of metapodia and phalanges, often correlated with traction, have rarely been noted on the cattle from Dayr al-Barshā (Table 25.5). Several ribs with healed or healing fractures were found, sometimes involving the formation of a callus (Fig. 25.10, c). Other ribs show strong periostic reactions or bony outgrowths (Fig. 25.10, a, b & d).

Some of the cattle skulls from Dayr al-Barshā clearly have the tip of either one or both horns removed (Fig. 25.11). Only the very top of the horn is taken off, and therefore no traces are visible on the horn cores. This is in contrast to a bucranium found at Kerma in Soudan (Bucranium 234 from Tomb KN24; Middle Kerma, ca. 2050–1750 BC) where the ends of the actual horn cores were sawn off (Chaix 2001). It was postulated that this was done to equip the horns with protective tips. For some of the cattle skulls from Dayr al-Barshā the possibility was considered that the horn shape had been artificially modified. Especially for skull 5 this thought was raised (Fig. 25.12). Possibly,

the horns of this skull were tied together in such a way that they grew more towards each other than they would do naturally, resulting in their almost ellipsoid shape. The present-day, East African Turkana deform the horns of their cattle, and it is thought that one type of deformation could give skull 5 as a result, although the Turkana apply it to obtain parallel horns (Chaix 1996). The pressure exerted on the horn cores during this process can create a typical swelling on the intercornual crest that was observed at Kerma on rather severely modified specimens with forward pointing horns (Chaix & Hansen 2003). Such intercornual bulges have not been observed on the Dayr al-Barshā skulls. Other direct indications on how the deformations would have been achieved, i.e. flattening of the horns (cf. Chaix & Hansen 2003), rope imprints, cutmarks, etc., are also missing. The possibility therefore remains that the horns from the animals at Dayr al-Barshā are not deformed but rather part of the natural range of horn shapes of ancient Egyptian Longhorns. Nevertheless, horn deformations are known in ancient Egyptian iconography, where cattle are sometimes depicted with one horn trained downward and forward and the other in a more normal upward and backward direction and of which also ethnographic parallels exist among Nilotic groups (Schwabe 1984; Boessneck 1988, 70–71; Vercoutter 1980).



Fig. 25.7. Pathologies on skulls from Dayr al-Barshā. a. Right maxilla of Skull 4 with an abnormally porous bone structure and light periodontitis; b. Displaced nasal bone of skull 5; c.–d. Skull 9 with a puncture in the right frontal bone.



Fig. 25.8. Detail of a mandible (N9) with an abnormally worn M1.



Fig. 25.9. Normal left naviculocuboid (AF8) and left naviculocuboid showing spavin (R7).



Fig. 25.10. Ribs with periostitis and bony outgrowths (a, b & d) and healing fracture (c) (From left to right: I1-AG19-I1-G8).

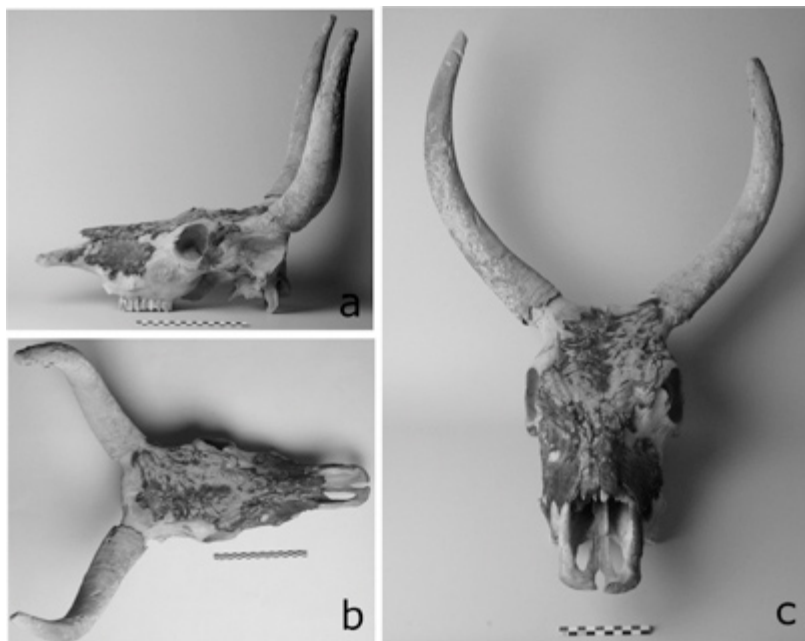


Fig. 25.11. Skull 6 with the left and right horn tips chopped off.

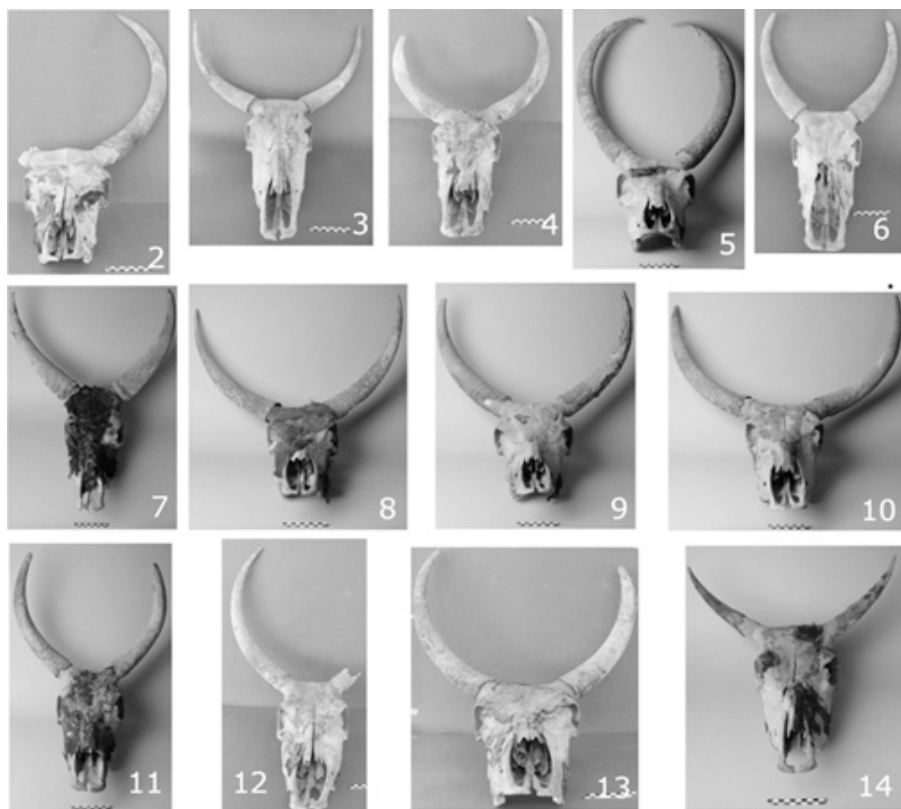


Fig. 25.12. The skulls of all adult cattle (Skulls 2–13) and of the

individual of 2–2.5 years (Skull 14).

Despite careful observation, not a single butchery or slaughtering trace was found on the bones. Some hooves and horns seem to have been affected by insects, quite severely so in the case of the left horn of skull 9 and in the case of the right horn of skull 12. A few beetle remains have been collected from the inside of some of the skulls, but they could not be identified. It is likely, however, that they belong to the category of scavenging taxa (Elias 1994). One rib has a clear green stain, which may be due to the presence of copper or bronze, although no metal objects were associated with the cattle bones.

Table 25.5. Draught related pathologies on phalanges and metapodia from Dayr al-Barshā (cf. Bartosiewicz et al. 1997). Pex: proximal exostosis, plip: proximal lipping, dex: distal exostosis, brd: distal broadening, fus: fusion

<i>No</i>	<i>Element</i>	<i>pex</i>	<i>plip</i>	<i>dex</i>	<i>brd</i>	<i>fus</i>
Y4	Metacarpal left		2	2	3	
AC2	Metacarpal right	2	2	2	3	2
E6	Metatarsal left			2		2
B7	Metatarsal right		2	2		
I2	phalanx 1 anterior external		2			
O10	phalanx 1 anterior external	2		2		
P2	phalanx 1 anterior external		2	2		
Q1	phalanx 1 anterior external	2	2	2		
G8	phalanx 1 anterior internal		2			
T1	phalanx 1 anterior internal		2	2		
AB1	phalanx 1 anterior internal	2	2			
V6	phalanx 1 posterior external	2				
E6	phalanx 1 posterior internal		2			
U1	phalanx 1 posterior internal		2			
W1	phalanx 2 anterior			2		
Y1	phalanx 2 anterior		2	2		
AG1	phalanx 2 anterior	2		2		
T1	phalanx 2 posterior		2			
T1	phalanx 2 posterior		2			
U1	phalanx 3 anterior			2		
O10	phalanx 3 anterior	3				
P3	phalanx 3 anterior		2			

} 1 individual

Bos africanus?

Ancient Egyptian Longhorns disappeared in the 19th century AD due to rinderpest epidemics (Grigson 1991). Apart from some older descriptions of mummies, skulls and skeletons of these animals (Dürst 1899; Lortet & Gaillard 1903; 1905; 1909; Jackson 1934), and the description of a complete oxen skeleton by Boessneck and von den Driesch (1987a), there are very few osteological data on this cattle type. The complete skeletons from Dayr al-Barshā thus represent a unique source of information on the osteomorphology and osteometry of ancient Egyptian Longhorns (Tables 25.4, 25.6–25.8).

The ancient Egyptian Longhorns are thought to belong to an indigenous African cattle type, different from zebu and taurine cattle, and that has been referred to as *Bos africanus* (Grigson 1991; 2000), although others consider them as crossbreeds between zebu and taurine cattle (MacHugh *et al.* 1997). Pia (1940) studied skulls of Egyptian archaeological cattle remains from different ages and came to the conclusion that they resemble taurines, but clearly not zebu cattle. When the skulls from Barsha are checked against the non-measurable criteria defined by Grigson (1980), to differentiate between zebu and taurine cattle, they fit usually better with zebu than with taurine cattle. All skulls have flat orbital rims for example. The persistence of flat orbital rims in older animals is typical for zebu, while in taurines they become sharp with age. Also the upward slope of the horns at the base is more zebu than taurine like. The shape of the sacrum of *Bos africanus* resembles that of taurines, but is said to be different from that in zebu type cattle (Grigson 1991; 2000). The cattle from Dayr al-Barshā also have sacral bones with a taurine shape. Six of the thoracic vertebrae from the cattle pit at the site have bifid dorsal spines (Fig. 25.13). Bifid dorsal spines in thoracic vertebrae are only rarely reported for taurine cattle, but are sometimes present in *Bos africanus* (Grigson 1991; 2000) and are common on some of the posterior thoracic vertebrae (6th–9th caudally) of the zebu type (Epstein 1971, 388). The long bones of *Bos africanus* are said to be slender, as in zebu, and unlike in taurine cattle. Logarithmic plots of maximal length and of distal breadth of metacarpals and metatarsals from Dayr al-Barshā, like those of other African cattle, fit with zebu (Grigson 1991; 2000). Osteometrical data on the cattle from Dayr al-Barshā fall in the range of other Egyptian cattle (Laudien 2000) and of animals from Kerma in Sudan (Chaix 2007). However, the fact that the Dayr al-Barshā population is mostly composed of a single sex makes comparisons with these other mostly unsexed datasets, otherwise not very meaningful.



Fig. 25.13. Thoracic vertebrae from Dayr al-Barshā with bifurcated neural spine (from left to right: D4-D4-L1-AG1-Y1-AG1).

Discussion

Methodological issues

The study of the cattle from Dayr al-Barshā revealed some methodological problems. The results of the different ageing methods are not entirely in agreement, although this is probably partly due to the castration of the animals that especially must have affected the age of bone suture closure. The analysis was also hampered by the fact that there is inadequate literature on how to identify castrates. Most methodological studies on sex determination are based on numerous male and female reference animals, but include few castrates (e.g. Grigson 1982; Sykes & Symmons 2007). The withers height reconstructions for the Dayr al-Barshā animals showed slight variations depending on the element used. This is related to variations in body proportions between cattle of different types, and to the different effect of castration on the length of each bone, depending on the age its sutures close. The cattle from Dayr al-Barshā showed a wide range in horn shapes that seems to exceed the variation known up to now. It is believed that this can be a result of the increased sample size, although it could also be used to argue that some of the horns were artificially deformed.

Life and death of the Barshā cattle

Archaeological and osteological data from the cattle pit at Dayr al-Barshā, allow the deduction of some details about the life and death of the animals. The pathologies observed on the ribs, and the healing perforations in the skulls, can all be due to fights among the animals. Violent behaviour may have occurred rather frequently when animals were kept closely together in stables, as was done with meat animals in ancient Egypt (Boessneck 1988, 68). The preserved hooves from Dayr al-Barshā are not particularly long and therefore do not suggest

inadequate wear due to a long stay in stables (cf. Boessneck 1988, 68). Although it is thought that the Egyptians dehorned some of their cattle (von den Driesch & Peters 2003, 14), the removal of horn tips has not previously been described. It may have been performed on the cattle from Dayr al-Barshā as a measure to reduce trauma in both cattle and the humans taking care of them. There exist some 19th century AD patent applications from the United States, US patent 373776 and 5237751, for machines designed to cut the top off cattle horns, exactly for this purpose (United States Patents and Trademark Office 2009).

Cattle, and especially oxen, were used in ancient Egypt for all types of heavy work (Boessneck 1988, 68). The cattle pit at Dayr al-Barshā dates to a period when the stone quarries near the site were intensively exploited and that animals potentially were put to work in the transport of stones. In fact, inside the quarries a cattle-drawn stone-cart seems to be depicted (Willems *et al.* 2009). However, the lack of traction related pathologies on the cattle bones from Dayr al-Barshā suggest that the animals did not serve such a purpose, or did so only for a short period.

It is known that, from the Old Kingdom onwards, castration was commonly practised on ancient Egypt cattle to optimise food and fat production (Boessneck 1988, 68). In addition, oxen were preferred for cattle offerings. However, there are no butchering or slaughtering marks on the Dayr al-Barshā cattle remains that would suggest the animals served as food or as food offerings. The presence of skin and hair also contradicts this.

Taphonomy

Before the cattle carcasses were placed inside the pit where they were eventually found, they were obviously disarticulated. Since no cut or chop marks occur, it is suspected that the carcasses were already disintegrated, falling apart naturally, before being buried. This initial rotting probably happened at some distance from the pit; at least the absence of some skeletal elements is suggestive of a loss during the transport between an unknown spot and the pit (see [Table 25.1](#)). Wherever the initial disintegration took place, carnivores had no access to the carcasses, as gnawing marks on the remains are absent.

Parallels

Burials of complete but articulated cattle are known in the Egyptian Nile Valley from the Predynastic period (ca. 4000–3050 BC) (Flores 2003; 2004) and even earlier, in the Western Desert of Egypt and beyond (Paris 2000; di Lernia 2006, Osypiński & Osypińska 2016).

The site of Kerma in Sudan is famous for the numerous cattle bucrania that have been found associated with human graves from the Middle Kerma period (ca. 2050–1750 BC) (Chaix 1988; 1993; 2000; 2001). There are no exact parallels for the cattle pit at Dayr al-Barshā, where the animals were found disarticulated, but the closest comparison is a foundation deposit of an 18th Dynasty (15th century BC) temple in Tell el Dab'a (Bietak 2002), in the Nile Delta in the north of Egypt. The deposit was a round pit with a diameter of nearly 2m and which contained all remains of four bulls and one ox. Inside this pit were also four complete but broken pottery vessels. Butchery marks are not mentioned in the report, but such marks may have been rendered invisible due the poor preservation of the material. The bones are partly burned and are considered remains of an offering and a ritual meal. Breaking pots and the slaughtering and eating of cattle have been linked with the symbolic destruction of the enemy (Müller 2008). There are some clear differences between Tell el Dab'a and Dayr al-Barshā. At Dayr al-Barshā hardly any pottery was found, which, in addition, is not necessarily contemporaneous. The Dayr al-Barshā bones were not burned and the animals' meat does not seem to have been consumed. Moreover, there is a chronological difference of more than 1000 years between the deposit at Tell el Dab'a and the cattle pit from Dayr al-Barshā.

The cattle burial of Barshā in a larger context

An avenue to a more promising line of enquiry is offered by the Münchner Ochsenmumie (Boessneck *et al.* 1987), dated to second half of the 1st millennium BC. In fact, this is not an actual mummy, but the skeletal remains of one ox wrapped in linen in the shape of a bull. Other cattle mummies are known that are sculptured out of the bones of several individuals (Lortet & Gaillard 1903, 58–59). No cut marks have been found on the bones of the Münchner Ochsenmumie. This has been explained by Boessneck and von den Driesch (1987) by referring to a passage of the Greek historian Herodotus, who wrote in the 5th century BC about how Egyptians treat their dead cattle. In passage 41 of his book II he writes:

‘the females they cast into the river, but the males they bury, each people in the suburb of their town ... and when the bodies have rotted away and the appointed time comes on, then to each city comes a boat from that which is called the island of Prosopitis. ... and when they have dug up the bones of the oxen they carry them off, and coming together they bury them in one single place.’ (Macaulay 1852–1915)

Lloyd (1976, 186–189) has argued that the Island of Prosopitis was Kawm Abū Billū in the Western Nile Delta. There is much evidence that such long-distance displacements of animal remains were very

common. For instance, in the Late Period (664–323 BC) the remains of ibises from all over Egypt seem to have been brought to the ibis galleries of Tūna al-Jabal (e.g., Kessler & Nur el-Din 2005). It is clear however that Herodotus cannot be describing a practice of a similarly general application as, in his day, there were bull cemeteries in many places in Egypt, some of which must have been far more important than the one in the Delta he is referring to. Rather he is describing a very specific case, and one that cannot fully explain the situation in Dayr al-Barshā. The cattle pit found there suggests (just as Herodotus describes) that the cattle were first left to decay (maceration), and then dug up to be roughly cleaned. However, they were not taken to Kawm Abū Billū, but reburied in Dayr al-Barshā itself. Again in keeping with Herodotus' report, they were buried there together in one pit. The additional bones from Barsha are from female animals that seem to have been brought from an environment in or close to the Nile, as suggested by the loam-clay loam sediment associated to the bones. This fits remarkably with Herodotus' description of the treatment of female dead cattle; although he does not mention that they were eventually buried together with the males.

Table 25.6. Cranial measurements (mm) according to von den Driesch (1976). Measurements for which special callipers are needed were not taken. When both sides were found associated (L&R), only the left side was measured. Note the marked difference in dimensions between the horns with horn sheath and the horn cores (cf. Grigson 1975).

Skull	Sk. 2	Sk. 3	Sk. 4	Sk. 5	Sk. 6	Sk. 7	Sk. 8	Sk. 9	Sk. 10	Sk. 11	Sk. 12	Sk. 13	Sk. 14
1 profile length	480	500	510	540	470	450	460	470	540	500	480	500	385
2 condylobasal length	465	490	480	520	470	460	460	470	500	500	470	490	390
3 basal length	430	460	450	490	440	430	420	435	460	465	440	460	365
4 short skull length	330	320	310	340	310	300	290	300	320	330	310	320	257
5 premaxilla length	140	140	150	150	130	130	120	110	140	140	130	140	113
7 viscerocranium length	256	280	280	300	220	–	–	250	280	–	250	–	199
8 median frontal length	220	220	220	240	260	–	–	220	250	–	230	–	185
9 frontal length	263	260	260	290	230	–	–	260	300	–	270	–	219
10 short upper cranium length	390	415	410	420	–	350	390	370	430	410	390	400	(303)
11 akrokranium-infraorbital of one side	360	380	380	410	360	340	370	350	430	390	360	390	273
12 greatest length of the nasals	170	190	190	180	–	–	–	160	180	–	150	–	121
14 lateral facial length	330	345	340	380	330	320	320	320	360	350	330	340	280
15 occipitale-infraorbital	320	340	330	370	330	330	310	320	350	350	330	350	271
16 infraorbital-prosthion	150	140	160	160	140	140	140	150	160	150	140	140	124
17 dental length	255	270	260	280	260	260	250	260	270	260	250	260	–
18 oral palatal length	202	196	210	230	200	190	190	200	200	190	190	200	164
19 lateral length of the premaxilla	155	150	140	160	130	130	130	140	150	–	125	170	128
20 cheektooth row length	126	137	129	133	138	130	130	137	140	140	135	130	–
21 molar row length	78	85	75	81	82	78	80	87	81	82	78	76	–
22 premolar row length	46	53	55	55	55	48	55	51	50	52	62	61	–
23 inner length orbit	52	70	68	73	65	62	66	65	70	67	70	60	45
24 inner height orbit	50	65	66	74	64	62	63	63	68	69	65	62	49

<i>Skull</i>	<i>Sk. 2</i>	<i>Sk. 3</i>	<i>Sk. 4</i>	<i>Sk. 5</i>	<i>Sk. 6</i>	<i>Sk. 7</i>	<i>Sk. 8</i>	<i>Sk. 9</i>	<i>Sk. 10</i>	<i>Sk. 11</i>	<i>Sk. 12</i>	<i>Sk. 13</i>	<i>Sk. 14</i>
25 mastoid breadth	198	207	214	232	210	196	191	219	222	216	210	216	152
26 breadth occipital condyles	105	107	102	117	100	105	106	114	105	111	105	117	89
27 breadth paraoccipital processes	150	160	158	170	152	145	146	257	155	165	162	162	118
28 breadth foramen magnum	30	28	37	43	29	40	40	30	33	38	39	31	23
29 height foramen magnum	41	37	37	40	35	41	36	40	41	38	42	35	24
30 least occipital breadth	118	132	126	131	134	117	141	144	118	131	138	141	99
31 least breadth between horncore bases	125	126	130	140	110	110	130	120	143	130	120	125	156
32 least frontal breadth	173	160	168	187	162	173	175	185	173	172	171	190	154
33 breadth across orbits	208	196	202	242	198	202	202	223	221	213	198	226	176
34 least breadth between orbits	151	148	150	175	153	156	147	161	180	161	169	170	130
35 facial breadth	135	135	141	166	142	140	138	160	158	159	146	152	123
36 breadth across nasals	44	51	63	55	—	—	—	53	60	—	49	—	44
37 breadth across premaxillae	78	77	87	93	85	82	80	93	90	88	75	89	67
38 palatal breadth	120	122	125	145	120	121	120	130	135	139	126	134	110
39 least inner height occipital groove	42	43	45	45	41	41	37	40	41	44	45	40	21
40 maximal occipital height	175	156	154	168	147	160	120	155	149	178	146	160	129
41 least occipital height	135	123	124	132	116	123	37	115	112	132	119	121	101
Horns without horn sheet													
42 least distance between horn tips	—	505	—	—	—	—	—	—	—	470	—	570	420
42a distance between horn tips - around curve	—	670	—	—	—	—	—	—	—	950	—	930	500
43 tangential distance between outer curves	—	505	—	—	—	—	—	—	—	500	—	570	420
44 basal circumference (BC)	190	180	210	225	200	210	200	215	215	205	180	200	135
45 greatest diameter base (DT-BA-GD)	63	60	73	73.5	66	70	65	72	70	70	59	68	46
46 least diameter base (DAP-BB-LD)	57	53	62	66	58	56	58	63	63	58	54	58	40
47 least outer curvature horn core	—	260	315	480	—	350	370	370	370	390	380	370	170
Horns with horn sheet													
42 least distance between horn tips	—	520	460	110	350	490	—	550	—	420	270	510	—
42a distance between horn tips: around curve	—	940	1060	1680	1000	1110	—	1130	740	1160	1320	1210	—
43 tangential distance between outer curves	—	530	530	550	450	530	—	590	1300	510	500	590	—
44 basal circumference (BC)	—	215	220	240	220	245	240	225	235	240	200	225	—
45 greatest diameter base (DT-BA-GD)	—	71	80	79	74	87	84	73	79	82	65	76	—
46 least diameter base (DAP-BB-LD)	—	61	61	72	63	66	58	64	63	68	56	62	—

<i>Skull</i>	<i>Sk. 2</i>	<i>Sk. 3</i>	<i>Sk. 4</i>	<i>Sk. 5</i>	<i>Sk. 6</i>	<i>Sk. 7</i>	<i>Sk. 8</i>	<i>Sk. 9</i>	<i>Sk. 10</i>	<i>Sk. 11</i>	<i>Sk. 12</i>	<i>Sk. 13</i>	<i>Sk. 14</i>
47 least outer curvature horn core	550	390	510	730	400	470	370	500	550	510	570	540	—
<i>Mandibula</i>	<i>H1</i>	<i>AG3</i>	<i>M3</i>	<i>Sk. 9</i>	<i>Sk. 2</i>	<i>P10</i>	<i>Sk. 12</i>	<i>AG5</i>	<i>AC10</i>	<i>K5</i>	<i>Sk. 13</i>	<i>AC6</i>	<i>AG17</i>
Side	L	L&R	R	L&R	L&R	R	R	L	L	L&R	R	L	L&R
1 length gonion caudale-infradentale	363	365	366	370	370	375	380	380	385	390	390	390	400
2 length condyle process-infradentale	372	385	374	380	390	412	400	420	400	405	410	415	420
3 length gonion caudale - M3	111	109	107	97	116	110	111	111	118	123	127	124	124
4 length M3-infradentale	252	269	256	261	257	263	262	263	263	266	260	260	275
5 length gonion caudale-M2	242	245	239	244	256	250	255	267	256	257	264	264	265
7 length cheek tooth row	132	139	134	105	131	138	135	139	136	131	132	131	140
8 length molar row	85	86	86	91	83	90	89	90	84	85	87	84	90
9 length premolar row	46	49	47	50	45	50	45	50	50	47	46	45	51
10 length M3	36	36	36	41	36	37	39	37	39	37	40	38	39
10 breadth M3	19.1	17.0	13.4	16.8	15.2	14.0	16.4	14.4	14.8	16.7	16.6	16.5	14.9
11 length of the diastema	107	97	110	102	115	110	110	107	114	119	111	118	114
12 aboral height ramus	(137)	147	152	149	147	154	127	144	157	154	158	149	173
13 middle height vertical ramus	(141)	148	146	159	155	156	153	156	153	143	161	150	168
14 oral length vertical ramus	(210)	210	221	232	218	224	234	231	227	217	230	231	240
15a height mandibula behind M3	79.1	73.8	78.2	69.5	71.8	78.6	75.0	78.4	77.0	71.3	79.3	79.0	88.0
15b height mandibula in front of M1	52.3	49.2	52.4	54.3	52.9	49.0	49.1	53.7	51.7	52.9	57.8	52.0	64.7
15c height mandibula in front of P2	35.7	36.5	37.7	39.6	46.5	36.1	40.8	42.2	42.0	42.0	46.9	45.0	44.6
<i>Mandibula</i>	<i>M12</i>	<i>Q5</i>	<i>AC9</i>	<i>L3</i>	<i>R4</i>								
Side	L	R	L&R	L	R								
1 length gonion caudale-infradentale	400	403	415	—	—								
2 length condyle process-infradentale	435	435	435	380	—								
3 length gonion caudale - M3	128	122	126	118	110								
4 length M3-infradentale	263	269	281	—	—								
5 length gonion caudale-M2	267	268	264	250	250								
7 length cheek tooth row	137	135	137	139	141								
8 length molar row	91	90	89	90	88								
9 length premolar row	46	—	48	50	53								
10 length M3	40	40	42	37	38								
10 breadth M3	16.0	18.9	17.7	13.8	13.8								
11 length of the diastema	120	122	125	98	—								
12 aboral height ramus	154	147	176	144	136								
13 middle height vertical ramus	156	159	174	150	153								
14 oral length vertical ramus	227	227	249	217	219								
15a height mandibula behind M3	79	71.5	79.4	74.9	75.6								
15b height mandibula in front of M1	50	51.4	51	50.3	51								
15c height mandibula in front of P2	44	45.4	45.5	37.9	37								

*Table 25.7. Measurements (mm) according to von den Driesch (1976) on postcranial bones of the complete cattle from Dayr al-Barshā. H1 on the pelvis according to Greenfield (2006). *unfused, **fusing; (): estimate.*

<i>Scapula</i>	<i>V9</i>	<i>Z2</i>	<i>AG16</i>	<i>U13</i>	<i>B6</i>	<i>U4</i>	<i>U9</i>	<i>Q4</i>	<i>Y2</i>	<i>T6</i>	<i>Y7</i>	<i>R10</i>	<i>Q13</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>
HS	280	285	335	335	(352)	355	355	357	365	370	370	375	380
DHA	290	285	335	335	(260)	360	375	360	375	370	370	380	380
Ld	145	145	171	—	(195)	181	176	178	175	184	188	198	197
SLC	41.9	44.6	52.6	52.0	58.6	56.6	69.0	52.4	58.5	56.7	57.5	61.8	59.3
GLP	58.7	59.3	73.4	76.8	75.3	68.4	75.2	68.3	72.8	73.3	74.6	68.8	73.6
LG	49.9	40.5	61.7	62.4	58.8	58.7	60.8	58.3	59.3	62.4	62.4	59.7	60.9
BG	39.7	—	50.7	50.8	50.6	49.1	48.8	49.2	50.2	49.5	56.7	49.5	53.6

<i>Scapula</i>	<i>AB6</i>	<i>G3</i>	<i>A9</i>	<i>T8</i>	<i>E14</i>	<i>S3</i>	<i>A12</i>	<i>C1</i>	<i>D1</i>	<i>C14</i>	<i>F9</i>	<i>H6</i>	<i>O5</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>
HS	380	390	(390)	395	400	400	420	—	—	—	—	—	—
DHA	—	—	(380)	395	395	—	420	—	—	—	—	—	—
Ld	—	194	200	189	190	—	200	—	—	—	—	—	—
SLC	55.8	50.2	54.2	53.6	56.5	61.7	64.4	55.3	55.3	54.5	58.8	65.5	60.2
GLP	78.8	67.2	—	73.2	72.5	70.5	87.5	77.7	76.0	77.9	73.5	85.8	72.1
LG	53.1	62.5	—	63.0	62.1	61.1	69.3	66.7	64.4	66.3	57.8	69.7	58.9
BG	—	52.8	—	49.3	48.7	56.7	58.7	52.5	50.8	46.4	49.2	56.0	55.9

<i>Humerus</i>	<i>M13</i>	<i>Q7</i>	<i>C4</i>	<i>C15</i>	<i>R2</i>	<i>Y14</i>	<i>P9</i>	<i>G1</i>	<i>G6</i>	<i>D7</i>	<i>AG1</i>	<i>R10</i>	<i>M10</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>
GL	311	312	315	(320)	(320)	323	324	325	326	328	328	330	331
Bp	98.0*	95.5*	101*	96.9*	96.5*	104*	98*	100*	98.5*	96.1*	99*	103*	106.7*
SD	38.6	41.2	40.1	41.6	34.1	37.3	32.7	37.3	35.5	35.3	33.5	37.1	38.6
Bd	82.5	85.9	77.0	82.2	89.3	89.1	81.8	83.5	86.5	85.7	96.9	87.2	90.5
BT	71.6	80.7	74.0	74.6	76.6	75.0	77.1	78.4	76.8	76.4	79.2	78.4	77.5

<i>Humerus</i>	<i>T3</i>	<i>V7</i>	<i>E9</i>	<i>D7</i>	<i>D9</i>	<i>N9</i>	<i>Z3</i>
<i>Side</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>
GL	335	335	336	355	363	364	365
Bp	111	99.3*	106	(107)*	112*	120*	125*
SD	37.1	33.8	39.0	41.6	41.0	47.7	44.7
Bd	95.0	95.2	85.8	96.1	87.9	94.0	103.7
BT	78.3	77.7	78.8	83.8	83.2	87.4	86.9

<i>Radius</i>	<i>V11</i>	<i>Z7</i>	<i>G2</i>	<i>N5</i>	<i>C13</i>	<i>AG11</i>	<i>U5</i>	<i>AF9</i>	<i>AG15</i>	<i>R6</i>	<i>K2</i>	<i>AE3</i>	<i>V12</i>
<i>Side</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>
GL	275	310	310	315	318	320	321	323	326	327	328	330	330
Bp	74.6	81.0	81.3	79.3	79.9	84.0	89.8	82.8	85.1	86.0	85.0	84.7	87.0
SD	32.2	43.3	45.6	40.6	40.8	40.7	43.9	40.2	39.2	43.6	40.5	40.0	43.1
Bd	73.3*	80.4	80.3	77.7	79.3	77.1*	(83)*	77.6*	77.6	77.7	78.8	77.3*	78.4

<i>Radius</i>	<i>L2</i>	<i>Q6</i>	<i>D11</i>	<i>AF4</i>	<i>V2</i>	<i>G1</i>	<i>E9</i>	<i>D9</i>	<i>S4</i>	<i>K6</i>	<i>U3</i>
<i>Side</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>
GL	331	335	336	340	340	340	344	346	348	370	370
Bp	84.3	85.3	86.5	85.9	87.7	86.3	87.3	93.0	93.7	90.6	91.7
SD	39.7	40.2	40.1	39.9	41.7	41.7	39.7	45.1	45.8	46.3	47.8
Bd	77.3*	74.3*	76.7*	79.7*	77.2*	81.3	84.9	85.1*	85.6*	90.3*	90.2

<i>Ulna</i>	<i>Y14</i>	<i>Z7</i>	<i>N1</i>	<i>U3</i>	<i>R6</i>	<i>K2</i>	<i>G1</i>	<i>S4</i>	<i>E9</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>
LO	96.8	97.3	109**	110.0	110.9	114	114.2	119.6	120.4
DPA	66.3	68.4	70.2	72.2	71.7	67.9	54.4	64.6	67.5
SDO	56.3	57.8	58.5	55.7	56.8	55.2	69.9	51.3	53.7
BPC	48.5	48.9	47.6	50.2	50.1	49.5	50.7	50.6	—

<i>Metacarpal</i>	<i>G1</i>	<i>C13</i>	<i>AC5</i>	<i>K4</i>	<i>Y14</i>	<i>F2</i>	<i>AG12</i>	<i>V10</i>	<i>AG15</i>	<i>V12</i>	<i>D11</i>	<i>W3</i>	<i>N3</i>
<i>Side</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>
GL	217	218	218	218	218	221	223	223	225	225	227	227	228
Bp	62.0	61.8	64.1	61.4	64.3	62.4	62.1	60.4	64.0	65.1	63.5	63.4	62.3
SD	31.9	33.3	34.3	33.8	35.2	33.0	32.2	33.7	32.5	35.7	32.9	35.4	33.5
Bd	64.1	61.6	68.2	64.0	68.1	60.9	66.6	64.6	67.0	67.5	62.7	67.1	63.2

<i>Metacarpal</i>	<i>M16</i>	<i>M15</i>	<i>AE2</i>	<i>AG11</i>	<i>T3</i>	<i>AG1</i>	<i>Y4</i>	<i>AC2</i>	<i>L5</i>	<i>Y4</i>
<i>Side</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>
GL	234	237	237	237	238	238	239	240	248	248
Bp	63.6	63.4	65.1	65.3	63.6	65.2	69.2	69.5	67.2	69.2
SD	33.4	36.3	34.2	33.2	34.1	35.6	42.0	41.8	36.7	38.3
Bd	65.2	66.9	66.1	66.1	66.0	66.8	75.5	75.4	69.4	70.2

<i>ph. 1 uni.</i>	<i>ADI</i>	<i>AG1</i>	<i>Q1</i>	<i>Y9</i>	<i>U1</i>	<i>Y9</i>	<i>F2</i>	<i>W1</i>	<i>V1</i>	<i>C13</i>	<i>C6</i>	<i>N4</i>	<i>F2</i>
GLPe	55.9	56.3	57.0	57.4	58.1	61.6	61.7	61.8	61.9	62.9	63.1	63.2	63.2
Bp	27.0	26.9	25.9	27.7	26.6	33.6	31.2	30.9	33.5	32.0	30.8	32.6	32.4
SD	24.1	23.2	24.5	25.4	25.2	28.9	28.6	28.0	29.7	27.4	28.0	27.3	27.4
Bd	27.9	28.5	28.9	28.6	27.2	31.9	31.5	30.5	31.3	28.1	31.5	30.3	28.7

<i>ph. 1 uni.</i>	<i>Y9</i>	<i>ADI</i>	<i>G4</i>	<i>C6</i>	<i>G8</i>	<i>AB1</i>	<i>AG1</i>	<i>AG1</i>	<i>U1</i>	<i>N1</i>	<i>V1</i>	<i>I0</i>	<i>AA1</i>
GLPe	63.3	63.8	63.8	64.3	64.3	64.4	64.5	64.6	64.7	64.8	64.9	65	65.0
Bp	33.7	28.1	33.0	30.8	33.3	33.2	30.6	34.1	34.4	33.0	31.9	29.8	33.2
SD	28.2	26.7	27.0	26.3	28.3	29.1	27.2	29.1	29.3	27.9	27.6	27.3	88.0
Bd	31.1	30.7	29.9	29.7	31.4	32.7	30.6	30.8	31.8	28.3	30.4	30.9	31.7

<i>ph. 1 uni.</i>	<i>D11</i>	<i>AE1</i>	<i>W1</i>	<i>AG1</i>	<i>X1</i>	<i>X1</i>	<i>I1</i>	<i>AG11</i>	<i>U1</i>	<i>M6</i>	<i>Q14</i>	<i>I0</i>	<i>T1</i>
GLPe	65.0	65	65.1	65.5	65.5	65.5	65.7	65.7	65.8	65.9	66.3	66.4	66.5
Bp	32.6	33.7	31.5	33.5	33.7	34.0	34.2	33.3	33.8	33.0	32.6	30.7	32.7
SD	27.8	28.6	27.2	28.4	28.4	29.0	28.3	26.6	31.2	27.8	28.3	26.6	26.2
Bd	31.0	31.4	29.6	33.4	31.4	31.2	33.6	31.0	32.2	31.8	32.6	29.0	30.8

<i>ph. 1 uni.</i>	<i>AG1</i>	<i>AD1</i>	<i>AG1</i>	<i>AG1</i>	<i>D5</i>	<i>D5</i>	<i>AG11</i>	<i>AG1</i>	<i>P3</i>	<i>P3</i>	<i>T1</i>	<i>AB1</i>	<i>Q1</i>
GLPe	67.0	67.1	67.4	67.4	67.5	67.9	68.6	69.7	69.7	69.8	70.0	70.1	70.4
Bp	33.0	32.1	34.2	32.3	32.0	32.6	34.7	35.9	34.9	30.9	37.6	38.1	38.6
SD	27.6	27.6	27.1	28.3	28.0	28.2	27.5	29.8	28.0	30.2	33.2	34.2	34.2
Bd	32.3	32.2	30.3	31.8	31.7	31.8	31.9	32.6	33.0	32.5	36.4	36.5	35.2

<i>ph. 1 uni.</i>	<i>AG1</i>	<i>P2</i>
GLPe	70.5	71.6
Bp	35.9	33.5
SD	28.0	30.3
Bd	33.3	32.6

<i>ph. 2 uni.</i>	<i>V1</i>	<i>P1</i>	<i>AG1</i>	<i>U1</i>	<i>W1</i>	<i>AG1</i>	<i>AD1</i>	<i>AG1</i>	<i>AE1</i>	<i>W1</i>	<i>F2</i>	<i>C13</i>	<i>Z1</i>
GL	33.9	34.8	35.1	35.3	35.9	36.0	36.2	36.3	36.6	41.4	41.5	41.6	42.7
Bp	31.6	28.6	29.8	29.0	29.9	28.4	29.4	29.6	30.2	30.4	30.9	30.2	31.9
SD	26.9	26.8	23.3	20.9	23.8	22.1	22.9	22.4	24.5	25.4	26.6	25.6	25.7
Bd	27.9	24.3	25.3	23.6	25.1	24.8	26.0	24.5	25.3	27.0	26.9	27.3	27.5

<i>ph. 2 uni.</i>	<i>AE1</i>	<i>AF1</i>	<i>X1</i>	<i>8(I)</i>	<i>AF1</i>	<i>Q1</i>	<i>AG1</i>	<i>AB1</i>	<i>Y9</i>	<i>M9</i>	<i>AC1</i>	<i>Y9</i>	<i>AC1</i>
GL	42.9	43.0	43.2	43.4	43.5	43.6	43.6	43.9	43.9	44.0	44.0	44.0	44.4
Bp	31.5	33.0	32.7	30.1	32.0	31.2	32.5	32.8	32.2	32.0	32.6	32.0	32.2
SD	27.4	26.8	28.0	25.5	25.3	26.3	26.9	26.9	27.1	27.5	26.6	27.8	28.1
Bd	30.0	30.1	30.7	26.8	27.1	27.3	30.3	28.9	29.5	28.8	29.2	29.2	27.9

<i>ph. 2 ant.</i>	<i>A41</i>	<i>D5</i>	<i>W1</i>	<i>G8</i>	<i>M6</i>	<i>AE1</i>	<i>O1</i>	<i>AG11</i>	<i>M6</i>	<i>V1</i>	<i>W1</i>	<i>Y1</i>	<i>G4</i>
GL	44.4	44.4	44.6	44.6	44.7	44.7	44.8	44.8	44.9	44.9	44.9	44.9	44.9
Bp	32.2	33.6	33.1	31.6	33.4	32.3	31.7	33.1	32.3	33.0	31.7	32.9	31.3
SD	26.3	28.4	29.1	25.4	27.4	27.8	26.7	26.8	26.6	27.5	27.6	27.2	25.4
Bd	29.0	28.4	30.8	28.5	30.4	29.7	27.6	29.4	29.3	29.1	28.8	29.1	29.5
<i>ph. 2 ant.</i>	<i>G4</i>	<i>AG1</i>	<i>AG1</i>	<i>Q14</i>	<i>AG1</i>	<i>I6</i>	<i>U1</i>	<i>Y1</i>	<i>U1</i>	<i>P3</i>	<i>T1</i>	<i>AG11</i>	<i>U1</i>
GL	45.2	45.2	45.2	45.2	45.8	45.8	46.2	46.2	46.3	46.6	47.0	47.3	47.5
Bp	31.9	33.5	33.5	32.5	32.4	30.0	37.1	33.6	33.6	33.0	36.4	33.0	37.1
SD	26.3	28.3	30.4	26.9	26.8	30.9	33.5	26.5	27.2	26.7	30.7	27.3	30.6
Bd	27.2	28.2	33.6	27.9	30.5	27.2	36.1	30.7	30.5	30.7	33.0	30.9	32.1
<i>ph. 3 ant.</i>	<i>8(1)</i>	<i>X1</i>	<i>I0</i>	<i>G4</i>	<i>AG11</i>	<i>M6</i>	<i>Y9</i>	<i>Q14</i>	<i>F2</i>	<i>Z1</i>	<i>AG11</i>	<i>M6</i>	<i>P3</i>
DLS	71.1	71.1	76.1	76.3	77.0	78.1	78.2	80.1	80.2	80.5	80.5	82.8	83.5
Ld	57.1	57.0	46.2	58.6	61.8	60.8	61.8	60.1	58.4	60.4	62.5	62.7	59.4
<i>ph. 3 ant.</i>	<i>M5</i>	<i>U1</i>											
DLS	84.2	92.5											
Ld	67.4	70.2											
<i>Felvis</i>	<i>P4</i>	<i>V4</i>	<i>U12</i>	<i>E13</i>	<i>N2</i>	<i>A3</i>	<i>AB5</i>	<i>O3</i>	<i>C10</i>	<i>U8</i>	<i>Y11</i>	<i>AG14</i>	<i>AA2</i>
<i>Side</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>
GL	480	—	—	—	—	—	—	—	—	—	—	—	—
LA	76.6	63.3	71	72.9	73	73.1	74.5	75.0	75.0	75	75	75.4	75.8
SH	41.3	30.8	41.0	39.7	43.7	42.5	37.1	42.9	39.2	38.5	45.9	40.4	46.7
SB	29.5	21.6	24.2	26.3	25.0	27.5	23.5	22.2	28.5	21.9	30.3	25.6	22.5
SC	110	86	110	110	115	113	106	106	115	105	123	110	118
LfO	—	71.4	77.9	89	90	—	83	95.8	83.0	80.4	78.6	93.7	118.8
H1	18.6	17.5	21.5	19.1	12.9	15.0	20.5	17.5	18.7	18.5	24.5	15.5	—
<i>Felvis</i>	<i>O6</i>	<i>AF3</i>	<i>Y10</i>	<i>U11</i>	<i>AG4</i>	<i>AC12</i>	<i>C9</i>	<i>AG7</i>	<i>H3</i>	<i>Q8</i>	<i>V3</i>	<i>AD3</i>	
<i>Side</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	
LA	75.9	76	76.8	77	77.5	78.0	78.8	79.9	85.6	86.0	86.6	88	
SH	40.5	46.6	42.4	41.9	47.2	42.9	39.6	42.5	49	46.0	45.8	48.5	
SB	22.6	29.0	23.6	24.0	23.5	25.3	30.1	26.3	27.6	32.3	34.0	29.1	
SC	105	123	112	108	120	113	112	117	122	125.0	130	132	
LfO	95.4	71.6	84.2	85.0	84.6	85	85.7	82.2	—	107.0	95.6	98	
H1	14.4	19.6	15.9	21.0	16.0	17.9	18.3	12.4	16.1	12.0	20.2	22.5	
<i>Femur</i>	<i>E2</i>	<i>F4</i>	<i>AC4</i>	<i>AG1</i>	<i>C8</i>	<i>X4</i>	<i>Q10</i>	<i>K3</i>	<i>AC11</i>	<i>AB2</i>	<i>AG12</i>	<i>AG1</i>	<i>AG6</i>
<i>Side</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>
GL	393	393	400	400	401	402	402	404	405	405	412	420	421
Bp	118*	117.3*	123*	127*	123.1*	124.6*	125.7*	123.3	118.7*	127*	120*	127*	129*
DC	47.0*	46.7*	48.5*	46.5*	48.3*	47.9*	48.3*	47.0	47.3*	46.1*	47.0*	49.3*	49.2*
SD	92.4	39.9	35.7	35.8	35.7	36.1	35.3	34.2	33.9	35.8	33.3	35.7	35.3
Bd	—*	90*	95*	97	93.3	96.3*	96.6*	102.7	100*	97.4*	100.5*	102.6*	98*
<i>Femur</i>	<i>AG13</i>	<i>O9</i>	<i>AD4</i>	<i>Z4</i>	<i>AD4</i>	<i>E12</i>							
<i>Side</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>							
GL	422	425	445	457	459	—							
Bp	126.0	126.6*	132*	138*	140*	116*							
DC	49.6	48.5*	51.2*	55.2*	55.5*	47.9*							
SD	35.5	36.7	41.4	40.3	41.6	35.8							
Bd	97.9	96.2	106*	114*	114*	98.8*							
<i>Tatella</i>	<i>AG1</i>	<i>C8</i>	<i>M1</i>	<i>8(2)</i>	<i>Q10</i>	<i>8</i>	<i>1i8</i>	<i>U8</i>	<i>W1</i>	<i>AD1</i>	<i>AG1</i>	<i>AB2</i>	<i>Y1</i>
<i>Side</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>
GL	52.3	65.3	66.4	67	67.6	67.9	68.4	69.3	69.3	69.4	69.5	69.7	70.1
GB	53.4	52.9	53.6	54	56.4	52.2	56.4	52.7	56.2	66.6	62.7	58.9	56.0

<i>Patella</i>	<i>AG1</i>	<i>Z1</i>											
<i>Side</i>	<i>R</i>	<i>L</i>											
GL	71.2	73.5											
GB	61.8	63.8											

<i>Tibia</i>	<i>A2</i>	<i>B1</i>	<i>AC4</i>	<i>C8</i>	<i>AF2</i>	<i>AF3</i>	<i>AG12</i>	<i>B8</i>	<i>E2</i>	<i>Q10</i>	<i>AB3</i>	<i>AC1</i>	<i>X6</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>
GL	375	376	377	378	393	395	400	401	402	403	405	418	420
Bp	95.9*	95.2*	95.8*	96.0*	97.8*	99.2	101.3*	102.8*	103.0*	98.3*	98.0*	101.0	100.3
SD	41.9	40.6	43.5	45.3	45.1	45.4	38.4	40.5	40.5	39.8	41.2	45.0	46.4
Bd	61.3	63.1	67.2	65.0	66.7	65.3	63.2	66.1	65.1	64.5	66.6	68.4	66.8

<i>Tibia</i>	<i>Y3</i>	<i>AD4</i>											
<i>Side</i>	<i>L</i>	<i>R</i>											
GL	451	452											
Bp	110.3*	111.7*											
SD	45.0	47.3											
Bd	72.1	70.6											

<i>Os malleolare</i>	<i>M1</i>	<i>H8</i>	<i>AD1</i>	<i>R3</i>	<i>AG1</i>	<i>M1</i>	<i>8(2)</i>	<i>AD1</i>	<i>R8</i>	<i>B7</i>	<i>Q10</i>	<i>C8</i>	<i>Y5</i>
GD	32.2	32.4	33.2	33.4	34.4	34.6	35.0	35.2	35.6	35.7	35.7	36.4	36.8

<i>Os malleolare</i>	<i>C16</i>	<i>AG1</i>	<i>R7</i>	<i>O1</i>	<i>L1</i>	<i>X1</i>	<i>AG1</i>	<i>V1</i>	<i>AF1</i>	<i>N1</i>			
GD	37.1	37.7	38.2	38.3	39.1	39.4	39.4	39.5	40.7	41.5			

<i>Naviculocuboid</i>	<i>M11</i>	<i>8(1)</i>	<i>R3</i>	<i>L4</i>	<i>AD1</i>	<i>Y5</i>	<i>Q1</i>	<i>B1</i>	<i>8(2)</i>	<i>Q10</i>	<i>R7</i>	<i>X1</i>	<i>AC1</i>
<i>Side</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>
GB	53.6	53.9	54.4	55.9	56.6	57.5	57.7	57.9	58.0	58.0	58.1	58.6	58.6

<i>Naviculocuboid</i>	<i>D5</i>	<i>AB1</i>	<i>H8</i>	<i>D12</i>	<i>AD1</i>	<i>N4</i>	<i>C8</i>	<i>Y13</i>	<i>AF8</i>	<i>T1</i>	<i>AD4</i>	<i>Z1</i>		
<i>Side</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>		
GB	58.6	58.7	58.9	58.9	59.1	60.1	60.8	61.2	63.2	66.2	66.5	66.7		

<i>Calcaneus</i>	<i>Y13</i>	<i>C8</i>	<i>A7</i>	<i>A1</i>	<i>L4</i>	<i>P7</i>	<i>N1</i>	<i>AB1</i>	<i>Q10</i>	<i>AF1</i>	<i>E3</i>	<i>R7</i>	<i>AD1</i>
<i>Side</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>
CL	138.2	138.3	142.4	143.4	144.6*	146	146.5	149.3*	150	151.3*	151.7	152*	152.6*
GB	52	49	43	44	42	50	43	47	50	47	44	48	45

<i>Calcaneus</i>	<i>AC1</i>	<i>AG1</i>	<i>W1</i>	<i>AG1</i>	<i>Z1</i>	<i>L4</i>	<i>L4</i>						
<i>Side</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>						
GL	153*	155.9	156*	156.5	157*	161.1	162						
GB	40	50	50	50	52	50	51						

<i>Talus</i>	<i>8(1)</i>	<i>R3</i>	<i>AG1</i>	<i>C8</i>	<i>P7</i>	<i>Y13</i>	<i>P1</i>	<i>E3</i>	<i>L4</i>	<i>B7</i>	<i>Y5</i>	<i>Q10</i>	<i>D7</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>
GLI	63.4	64.1	65.5	66.1	67.8	68.3	69.0	69.7	70.4	70.8	71.7	71.8	71.9
CLm	60.2	61.1	61.2	60.7	65.0	61.3	65.7	66.5	66.5	66.3	67.4	67.0	66.7
DI	35.3	35.4	35.7	37.6	36.9	38.3	38.0	37.6	38.3	38.1	40.5	38.6	39.1
Bd	42.0	42.5	41.4	45.6	44.4	46.7	43.3	44.3	46.1	45.0	46.1	45.8	46.8

<i>Talus</i>	<i>P7</i>	<i>AG1</i>	<i>S1</i>	<i>AG1</i>	<i>T1</i>	<i>C16</i>	<i>AC1</i>	<i>AG1</i>	<i>T1</i>	<i>AF1</i>	<i>R7</i>	<i>AG1</i>		
<i>Side</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>		
GLI	73.2	73.4	73.6	74.3	74.7	74.8	77.3	77.6	77.7	78.1	78.2	79.0		
CLm	67.6	67.8	66.8	67.1	70.9	70.0	70.4	73.7	69.9	68.3	68.5	72.3		
DI	40.2	40.8	39.9	40.5	40.9	41.4	41.5	43.0	40.5	41.2	41.4	43.0		
Bd	44.2	43.3	45.2	43.2	48.5	49.5	47.3	47.8	47.6	45.5	46.3	49.4		

<i>Metatarsus</i>	<i>V13</i>	<i>A7</i>	<i>Y13</i>	<i>C8</i>	<i>A1</i>	<i>E6</i>	<i>Y5</i>	<i>D12</i>	<i>B8</i>	<i>B7</i>	<i>D11</i>	<i>Z5</i>	<i>Q10</i>
<i>Side</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>R</i>
GL	249	254	254	254	255	256	256	256	256	258	260	260	262
Bp	51.4	49.6	52.4	52.6	51.2	51.1	51.4	52.1	52.2	50.7	52.0	52.6	52.9
SD	29.4	28.0	29.5	30.9	28.5	29.1	28.3	29.3	29.9	29.9	29.2	31.1	28.2
Bd	58.5	55.5	61.1	61.1	55.9	62.6	61.1	61.6	58.6	62.7	57.8	60.7	57.9

<i>Metatarsus</i>	<i>AF7</i>	<i>I5</i>	<i>F5</i>	<i>H4</i>	<i>Q12</i>	<i>V6</i>	<i>AG1</i>	<i>AD4</i>	<i>Y4</i>	<i>AF8</i>	<i>AD4</i>
<i>Side</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>L</i>	<i>L</i>	<i>R</i>	<i>L</i>
GL	263	264	270	270	271	272	272	272	273	289	291
Bp	53.4	51.3	50.3	57.6	50.9	51.4	52.7	57.1	51.6	56.1	55.2
SD	29.9	30.1	31.4	34.4	33.3	31.3	30.4	35.7	29.9	32.8	32.3
Bd	60.8	58.3	61.4	65.6	61.0	60.9	59.2	67.0	61.2	64.3	63.9

<i>ph. 1 post.</i>	<i>AG1</i>	<i>AG1</i>	<i>Q9</i>	<i>T1</i>	<i>AD4</i>	<i>A7</i>	<i>G8</i>	<i>A7</i>	<i>Y12</i>	<i>T1</i>	<i>Y12</i>	<i>Q10</i>	<i>S1</i>
GLpe	58.6	59.4	60.0	62.7	62.7	63.7	63.8	64.0	64.5	65.2	65.5	66.0	66.0
Bp	26.1	26.6	27.0	33	33.3	28.0	29.6	29.9	30.0	32.4	30.8	28.7	30.3
SD	22.2	23.3	23.8	29.7	28.2	25.9	25.4	24.8	26.4	27.6	26.0	25.0	26.5
Bd	27.7	27.4	27.0	32.5	30.4	28.4	26.9	27.4	30.4	30.9	29.2	29.1	29.2

<i>ph. 1 post.</i>	<i>I5</i>	<i>V6</i>	<i>V6</i>	<i>I5</i>	<i>D13</i>	<i>AA1</i>	<i>T1</i>	<i>P8</i>	<i>AG1</i>	<i>M1</i>	<i>AG1</i>	<i>Q14</i>	<i>P8</i>
GLpe	66.2	66.4	66.6	66.6	66.8	66.9	67	67.1	67.3	67.3	67.4	67.5	67.5
Bp	30.8	31	31.7	30.7	28.9	29.3	30	30.5	31.1	30.2	31.3	30.8	30.8
SD	25.3	27.2	27.3	24.5	25.2	25.0	26.8	27.8	30.9	24.8	26.0	27.6	25.5
Bd	29.0	30.6	28.8	28.0	29.5	29.0	29.4	34.5	28.6	27.6	29.6	31.6	29.9

<i>ph. 1 post.</i>	<i>D13</i>	<i>E6</i>	<i>Q10</i>	<i>E6</i>	<i>V1</i>	<i>M9</i>	<i>P2</i>	<i>Y1</i>	<i>AD1</i>	<i>AC1</i>	<i>E6</i>	<i>D12</i>	<i>X1</i>
GLpe	68.1	68.4	68.5	68.6	68.9	69	69.4	69.5	69.5	69.6	69.7	69.9	70.0
Bp	29.4	29.8	29.6	29.6	31.3	29.7	30.1	30.5	31.6	30.1	31.4	30.0	30.2
SD	26.0	25.0	25.8	24.9	24.4	25.6	26.2	24.4	25.2	25.9	24.7	27.1	25.8
Bd	28.5	30.9	29.0	29.7	30.9	-	30.1	27.2	28.6	30.0	29.4	32.4	28.5

<i>ph. 1 post.</i>	<i>AD4</i>	<i>AD4</i>	<i>U1</i>	<i>AF8</i>	<i>AF8</i>	<i>AG1</i>
GLpe	71.7	72.1	72.3	72.5	72.6	73.6
Bp	33.9	32.9	33.4	33.9	33.3	33.1
SD	25.0	27.8	31.1	28.0	28.4	28.6
Bd	30.9	32.7	32.5	30.9	31.8	31.8

<i>ph. 2 post.</i>	<i>R1</i>	<i>Z1</i>	<i>AG1</i>	<i>A7</i>	<i>8(2)</i>	<i>AD1</i>	<i>AC1</i>	<i>Y1</i>	<i>AD4</i>	<i>Q10</i>	<i>D13</i>	<i>N8</i>	<i>F7</i>
GL	40.4	40.7	42.2	42.8	43.1	43.1	43.8	43.9	44.1	44.8	44.9	45.0	45.1
Bp	27.6*	22.9*	28.5	28.5	29.6	28.8	29.7	30.9	32.1	29.4	29.1	29.7	29.4
SD	23.8	23.1	23.3	24.1	23.5	24.8	25.2	26.3	27.1	24.9	24.7	23.0	23.3
Bd	22.9	23.8	25.1	25.5	25.3	26.6	27.1	27.3	30.3	25.2	24.5	24.3	25.8

<i>ph. 2 post.</i>	<i>Q1</i>	<i>AE1</i>	<i>U1</i>	<i>D13</i>	<i>Q10</i>	<i>C6</i>	<i>F7</i>	<i>Y12</i>	<i>P8</i>	<i>V1</i>	<i>I5</i>	<i>U1</i>	<i>Y6</i>
GL	45.1	45.2	45.3	45.4	45.4	45.5	45.5	45.6	45.6	45.7	45.8	45.8	45.9
Bp	26.6*	28.9	29.0	30.1	29.1	30.3	29.9	30.8	30.4	30.6	30.1	29.9	29.1
SD	22.1	24.4	24.5	24.9	24.3	25.2	23.9	25.2	24.5	25.1	24.2	25.7	26.1
Bd	24.1	26.3	26.4	24.9	25.5	27.4	25.6	27.6	27.4	27.2	26.3	26.7	27.9

<i>ph. 2 post.</i>	<i>Y1</i>	<i>D7</i>	<i>X1</i>	<i>C16</i>	<i>M9</i>	<i>AG1</i>	<i>P8</i>	<i>Y1</i>	<i>N4</i>	<i>T1</i>	<i>T1</i>	<i>AG1</i>	<i>D12</i>
GL	46.0	46.1	46.2	46.3	46.5	46.6	46.6	46.7	46.8	46.8	46.9	47.2	47.2
Bp	29.6	31.9	29.7	31.6	30.2	31.5	33.5	30.3	30.5	30.8	30.2	30.5	32.3
SD	24.1	26.8	24.6	26.1	25.0	25.8	26.7	25.0	24.9	25.3	24.4	26.0	25.6
Bd	27.3	28.3	27.1	26.4	27.2	25.3	26.3	27.4	25.6	25.6	28.2	25.3	26.7

<i>ph. 2 post.</i>	<i>E6</i>	<i>T1</i>	<i>AF8</i>	<i>Y1</i>	<i>Y1</i>	<i>AD4</i>	<i>AD4</i>	<i>T1</i>	<i>AB1</i>				
GL	47.4	48.2	48.6	48.7	48.9	49.1	49.2	49.2	50.0				
Bp	29.8	35	31.1	34.2	34.6	31.9	30.7	34.4	31.8				
SD	24.8	28.9	24.6	27.8	30.0	25.7	24.4	28.9	25.4				
Bd	25.0	29.7	27.5	29.1	29.2	27.7	27.8	29.7	28.2				

<i>ph. 3 post.</i>	<i>M9</i>	<i>N4</i>	<i>N8</i>	<i>P8</i>	<i>Y1</i>	<i>D13</i>	<i>Y12</i>	<i>A7</i>	<i>D13</i>	<i>D12</i>			
DLS	69.9	81.1	66.7	70.2	65.2	75.2	74.5	74.8	73.4	68.1			
Ld	58.9	61.3	53.4	57.5	56.8	60.5	62.8	58.6	62.5	57.8			

<i>ph. 3</i>	<i>AG2</i>	<i>V1</i>	<i>U1</i>	<i>E15</i>	<i>AG1</i>	<i>AG2</i>	<i>V1</i>	<i>AD1</i>	<i>F7</i>	<i>Y1</i>	<i>AD1</i>	<i>X1</i>	<i>AC1</i>
DLS	56.4	56.6	56.7	57.7	58.0	58.6	58.8	58.8	58.9	61.8	62.9	63.0	63.5
Ld	44.7	62.8	45.0	48.6	46.0	49.3	47.1	43.9	47.0	47.4	49.2	49.4	49.0

<i>ph. 3</i>	<i>S1</i>	<i>H8</i>	<i>AC1</i>	<i>T1</i>	<i>AG1</i>	<i>AG1</i>	<i>AA1</i>	<i>A6</i>	<i>X1</i>	<i>AG1</i>	<i>U1</i>	<i>E15</i>	<i>E15</i>
DLS	66.6	67.5	67.6	68.7	69.5	69.6	69.8	69.8	70.1	70.3	70.3	70.5	70.6
Ld	56.1	55.6	56.3	55.0	56.6	55.8	55.8	56.6	55.1	58.6	56.8	55.0	54.4

<i>ph. 3</i>	<i>D10</i>	<i>Q10</i>	<i>T1</i>	<i>T1</i>	<i>AG1</i>	<i>P6</i>	<i>AB1</i>	<i>Y1</i>	<i>AC1</i>	<i>Q10</i>	<i>AB1</i>	<i>AG1</i>	<i>AG1</i>
DLS	71.4	71.6	71.7	72.0	72.2	72.2	72.9	73.1	73.1	73.3	73.5	73.5	73.5
Ld	55.8	56.2	57.5	56.3	57.4	56.8	56.1	56.3	56.5	61.5	56.8	56.6	61.4
ph. 3	Y1	AG1	M1	Q10	P6	D10	U1	P6	AA1	AG1	Q1	A6	AG1
DLS	73.9	74.4	74.4	74.4	74.9	75.0	75.5	75.8	76.9	77.0	77.7	78.0	78.1
Ld	62.0	61.8	60.8	60.6	60.7	58.3	58.3	60.7	61.1	61.0	60.3	59.5	59.4

<i>ph. 3</i>	<i>AG1</i>	<i>X1</i>	<i>AE1</i>	<i>X1</i>	<i>N8</i>	<i>U1</i>	<i>Z1</i>	<i>Y1</i>	<i>AG1</i>	<i>V1</i>	<i>W1</i>	<i>AB1</i>	<i>AD4</i>
DLS	79.1	79.3	79.3	79.5	79.7	80.0	80.2	80.7	80.7	81.0	82.0	82.5	83.0
Ld	60.5	61.6	58.7	59.7	57.7	60.6	62.4	61.9	60.1	60.4	60.3	62.5	58.8

<i>ph. 3</i>	<i>AG1</i>	<i>U1</i>	<i>AA1</i>	<i>U1</i>	<i>Y1</i>	<i>AG1</i>	<i>Y9</i>	<i>AB1</i>	<i>AA1</i>	<i>T1</i>			
DLS	83.2	83.3	83.7	83.7	83.9	85.3	86.0	91.1	91.2	93.4			
Ld	64.2	68.1	59.7	62.4	67.8	64.5	64.7	70.9	72.2	70.0			

<i>Atlas</i>	<i>AE1</i>	<i>U1</i>	<i>Sk. 2</i>	<i>Q1</i>	<i>Sk. 12</i>	<i>T1</i>	<i>B3</i>	<i>Sk. 11</i>	<i>Sk. 13</i>	<i>Sk. 10</i>	<i>Sk. 9</i>	<i>D8</i>
GB	138	146	150	155	157	157	167	168	177	185	185	—
GL	100	95	90	105	105	105	113	110	106	109	112	110
Bfed	108	106	105	98	108	120	106	110	110	107	107	114
CLF	100	93	96	94	105	—	97	106	98	103	103	100
LAd	90	82	84	81	87	86	74	90	90	82	92	90
H	80	80	75	80	76	80	85	75	80	75	80	82

<i>Axis</i>	<i>B5</i>	<i>M1</i>	<i>M2</i>	<i>Q1</i>	<i>Sk. 2</i>	<i>X8</i>	<i>X8</i>	<i>Y1</i>	<i>AE1</i>	<i>AE1</i>	<i>Sk. 9</i>
LCDe	120	110	132	104	123	105	124	108	112	98	126
LAPa	95.4	104.4	103.7	90.1	88.4	95.1	96.0	94.7	88.8	86.1	91.3
BFer	95.5	102.9	103.3	89.1	99.3	100.3	98.6	94.3	102.1	95.8	100.0
Bpaed	68.3	69.7	66.6	68.4	64.5	65.0	63.6	64.7	66.7	59.0	68.8
BPir	98.5	108	111.6	90.0	83.6	102.2	103.9	94.4	89.6	82.0	110
SBV	50.8	58.3	55.9	50.5	54.6	58.1	58.4	49.1	53.2	59.5	57.0
BFed	51.0	49.8	51.1	46.3	46.8	45.5	48.5	49.7	45.0	45.7	51.3
H	—	132	141	113	120	120	130	120	115	105	130

<i>Sacrum</i>	<i>C11</i>	<i>T4</i>	<i>H5</i>	<i>A11</i>	<i>O4</i>	<i>X5</i>	<i>AD2</i>	<i>Y6</i>	<i>AG10</i>	<i>S3</i>	<i>M7</i>
GL	234	238	274	—	—	—	—	—	—	—	—
PL	223	253	—	220	238	—	—	—	—	—	—
GB	193	214	217	205	203	162	(178)	132	187	(195)	—
BFer	65.5	69.2	68.3	63	64.0	64	75	63.3	61.8	51.2	63.4
HFer	31.7	32.2	34.1	30.5	30.7	28.2	28.8	27.4	30.3	30.5	27.7

Table 25.8. Measurements (mm) according to von den Driesch (1976) on postcranial bones of the additional cattle from Dayr al-Barshā.

[illegible]

Although not much has yet been published about the practice, there is mounting evidence to show that, before the second Persian occupation of Egypt (343–332 BC), it was common to macerate the remains of dead animals by burial before they were committed to their last resting place. This could recently be shown, for instance, by a careful study of the chronological variations in body treatment in the ibis catacombs at Tūna al-Jabal (von den Driesch *et al.* 2005). It is important to note that the animal remains found not only belong to ibises, but also to various other animals including cattle. The cattle remains found in the catacombs of this period had also been macerated (D. Kessler pers. comm.).

While the treatment of the bones in the studied cattle pit thus strongly resembles that of the animals found in the catacombs at Tūna, it is still necessary to explain why this would have happened at Dayr al-Barshā, where there is no other evidence of animal burials linked to a temple cult. The explanation should moreover take into consideration the date of the deposit, 410–360 cal BC. After the New Kingdom, there is, for about a millennium, no evidence of human activity at the site, but in the reigns of pharaohs Nectanebo I (380–363 BC) and Nectanebo II (360–343 BC), huge limestone quarries were opened there. It seems more than likely that the cattle deposit

should be linked to the activities of the former ruler. Textual evidence inside the quarries and on a stela from al-Ashmūnayn, dated year 8 of Nectanebo I, suggests that a major aim of the quarry activities was the construction of a huge pronaos in the temple of Thoth in al-Ashmūnayn (Willems *et al.* 2004; in press). Since ancient Egyptian temples were economic institutions as much as centres of religious cult, it is likely that the Thoth temple was directly involved in the organisation of the quarry exploitation in Dayr al-Barshā. Now Kessler (1995) has demonstrated that large cattle herds were linked to the Thoth cult in the region, which was concentrated in al-Ashmūnayn and Tūna al-Jabal. Both localities are just on the opposite side of the Nile at Dayr al-Barsā. From these herds, animals could be selected to serve as the cult animal or Thoth-bull, or as sacrificial animals, but most would be involved in more mundane tasks (as providers of meat or milk, or as draught-animals). It stands to reason that some herds were directed to the quarries. Possibly they were not deployed long for work there, since they had developed little pathologies related to draught activities. It is clear that, after their death, they were not transported to the animal catacombs at Tūna. Instead, they were committed to the earth close to the quarries where they may have been engaged. Their place of burial, suggests, however, that they were not unceremoniously discarded. The burial pit is located in what was, already in the 4th century BC, a very ancient cemetery, and in fact in an older tomb shaft that was slightly enlarged. Since Egyptian funerary symbolism revolved around the theme of the dead being transformed into a form of Osiris, it must have been a small step to envisage the cemetery as the realm of Osiris, precisely as the catacombs at Tūna were. If this is the correct interpretation, it seems that those responsible for the cattle burial may have transferred the ideology of the large, official animal cemeteries to this spontaneous deposit on the desert edge of Dayr al-Barshā.

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26. The Opet Temple courtyard excavations: a new zooarchaeological study for Karnak (Luxor, Egypt)

Hervé Monchot & Guillaume Charloux

The archaeological excavations undertaken in 2006 and 2007 in the courtyard of the Opet Temple at Karnak (Luxor, Egypt) revealed, in 12 soundings, nine phases of occupation and/or construction dating from the end of the 3rd millennium BC to the present. In addition to an abundance of artifacts (ceramics, stone tools, seal impressions, shells, etc) more than 5000 faunal remains were recovered belonging for the most part to the classic domesticates (sheep/goat, cattle and pig) in addition to Nile fishes. Zooarchaeological analysis shows that the majority of bones are burned and that the Egyptians preferentially consumed young animals, lambs/kids, calves and piglets. This study offers a rare insight into the fauna of Karnak, and allows us to give a first glimpse on the life and the behavior of Thebans at the time of the emergence of the Amun cult.

Keywords archaeozoology, Egypt, Thebes, Middle Kingdom, New Kingdom, domestic animals, fish

Introduction

Located 3km north of Luxor (Egypt), the complex at Karnak ([Fig. 26.1](#)) was the heart of religious activity during the New Kingdom (1550–1070 BC), as well as an important economic centre. Three main temples dedicated to Mut, Montou and Amun constitute a 40ha religious complex, which was presumably erected at the beginning of the Middle Kingdom, ca. 2100 BC, if we take into consideration results of recent excavations in the central area of the Amun sanctuary (Charloux *et al.* 2004).

Although New Kingdom Karnak has been studied in detail, little is known of the periods preceding the monuments of the XVIIIth Dynasty kings. Obtaining information on the daily life of Thebans in particular has been neglected in favor of architectural and epigraphic research. Zooarchaeological investigations have always been considered as a secondary factor (McArdle 1989), which accounts for the absence of faunal reports for Middle and New Kingdom contexts. Most often the presence of bones is limited to a mere mention in publications (Debono 1982), although animal offerings, such as those found in foundation deposits (Azim 1982) or represented on tombs or temples reliefs (Beaux 1990), that is to say those associated with rituals, have been studied in somewhat greater detail.

The animal world deeply shaped Egyptian religion and imagery. Gods and goddesses are represented with the attributes of wild or sometimes tame animals, predatory birds, crocodiles, hippopotamus and others. Suffice to say that this animal world, like the whole environment, was a gift of the divine to the Thebans. Nevertheless, studies describing the economic behavior of local populations and their mode of exploitation of animal products in such a cultural sphere are still surprisingly missing. The lack of deeply stratified deposits at Karnak represents a major challenge in this matter. Two notable exceptions are current incomplete published works from a priests' residential area located South-east of the Sacred Lake at Karnak (Millet 2007) and from a domestic quarter at North Karnak (Jacquet 2001).

The Opet Temple

The temple of Opet is situated immediately to the west of the Khonsu temple (Fig. 26.2), in the southwest corner of the precinct of Amun at Karnak. It was dedicated to the hippopotamus goddess Opet by Ptolemy VIII Euergetes II (2nd century BC), and constitutes one of the last cult buildings erected in Egypt. Its decoration was carved until the reign of the Roman emperor Augustus Caesar (1st century BC–1st century AD), but the monument was left unfinished.

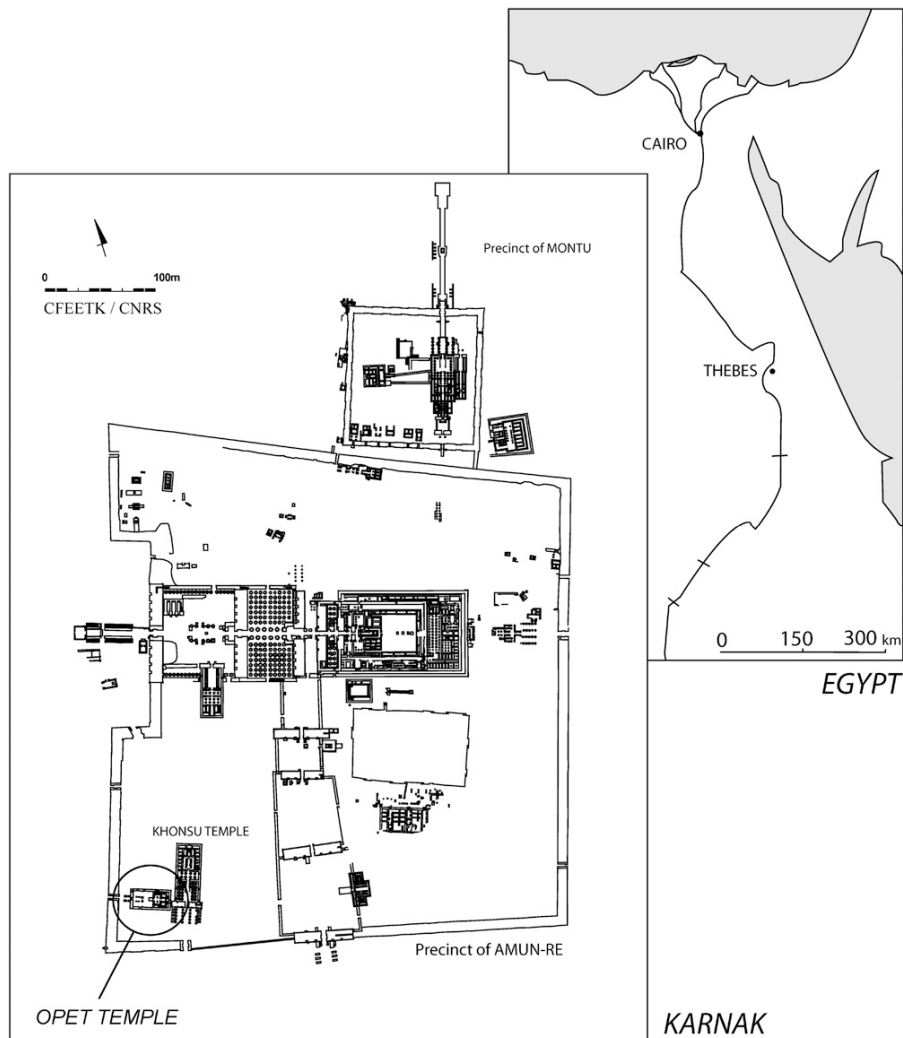


Fig. 26.1. Egypt map showing the Theban area on the Nile. Foreground, the location of temple sites within Karnak

Although rather small in comparison to other sanctuaries, this temple presents a lot of unique features (location, plan, methods of construction, function, etc). It belongs to a very rare category called the ‘mythological temples’, like the *mammisi*. Originally, the concept of god as a divine entity was not the major goal of the cult, which focused more on the myths in which he was involved. This temple is dedicated to the goddess Opet in order to commemorate the main events of the life of her son Osiris: birth and resurrection, heir of God Amun, as well as the birth of Horus (Traunecker 2004).

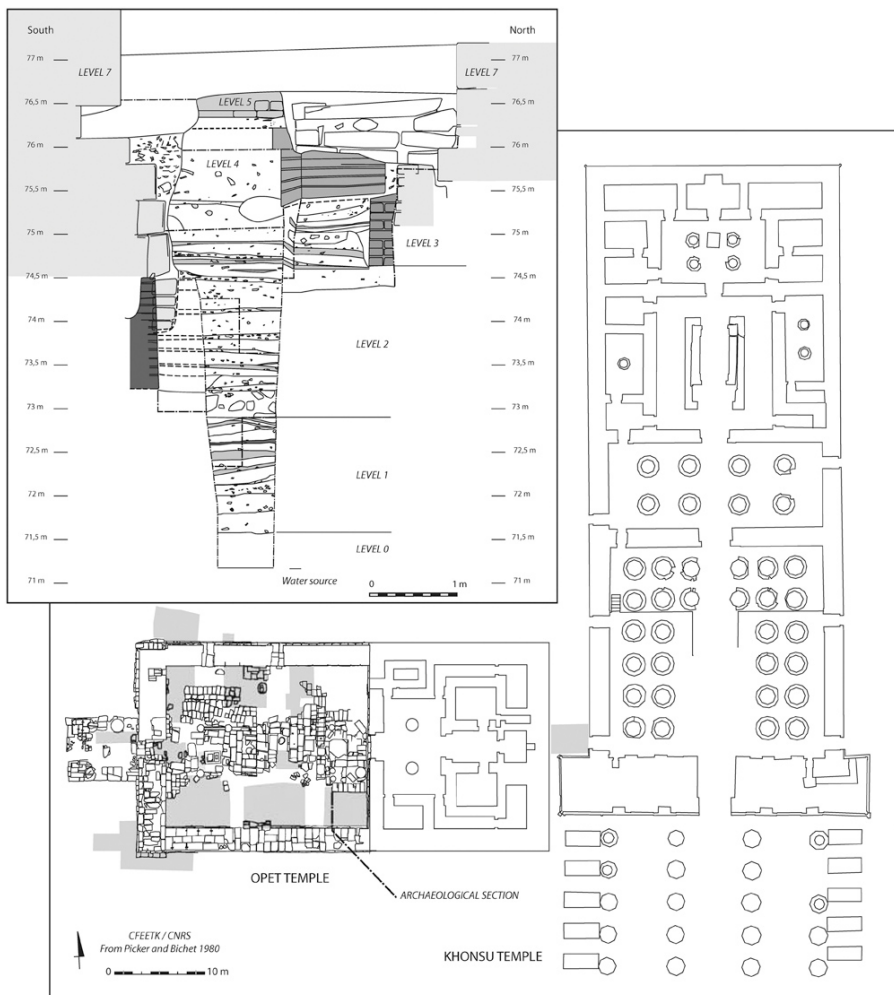


Fig. 26.2 Plan of the archaeological soundings in and around the Opet Temple courtyard and (inset) the deep section, with distinction of levels above the water table.

Stratigraphy, chronology and structural remains

Since 2005, a conservation and tourism management project has been undertaken under the direction of E. Laroze (architect, CNRS/CFEETK). This multi-disciplinary programme is a collaboration between the CNRS/MAE and the Egyptian Supreme Council of Antiquities. Two excavation campaigns in the courtyard of the temple were conducted by G. Charloux in 2006 and 2007 to answer specific architectural and archaeological questions, for instance the origin and the sequence of periods of occupation at the site (Charloux *et al.* 2009).

Nine archaeological levels were distinguished (Table 26.1), and a

sounding reached the basal geological soil, revealing one of the deepest archaeological sequence uncovered at Thebes (five levels and 27 layers under the surface) (Fig. 26.2). Furthermore, the archaeological and architectural complexity found under the Opet temple seems to reflect a wide variety of contexts: domestic occupation (levels 1–3), production or storage facilities, monumental construction of unknown nature (level 4) and religious building (levels 5–9). As a consequence, this archaeological study offers a unique chance to understand the past of the whole area. No archaeological research undertaken in a 170m radius around the monument has as yet exposed structures older than the Ramessid period. With the exception of few superficial diggings, some of them incomplete or unpublished, the sector is clean of work. Concerning the archaeological levels we are especially interested in the XIth–XVIIIth dynasties (levels 1–4) according to ceramic studies – the only published data or ongoing excavations are located more than 350m away to the north or to the east (e.g. Charloux 2005; Millet 2007). For more archaeological information, the reader can refer to the review *Les cahiers de Karnak* published by the CFEETK (*Centre franco-égyptien d'étude des temples de Karnak*) and the CNRS (*Centre National de la Recherche Scientifique*) since 1968.

Table 26.1. Stratigraphical sequence of the Opet Temple courtyard excavations.

<i>Levels</i>	<i>Period</i>	<i>Preliminary relative ceramic dating</i>	<i>Preliminary relative chronology related to ceramic study</i>	<i>Archaeological context</i>
0	--	Virgin soil	--	--
1	MIDDLE KINGDOM TO EARLY NEW KINGDOM	XIth–XIIth dynasty	2100–1750 BC	Occupation floors
2				
3				
4	KINGDOM	XIth–XVIIIth dynasty	2100–1400 BC	Foundation filling
5	LATE EPOCH ? TO RECENT PERIODS	XXVth dynasty according to stratigraphy (?)	7th century BC according to stratigraphy (?)	Foundation filling
6		XXVth dynasty	7th century BC	Temple foundation
7		until the Hellenistic period	until 2nd century BC	Temple foundation
8		until the Late Roman period	until 4th–7th century AD	Pit
9		medieval and modern periods according to stratigraphy	until 2008	Pit

During excavation of 12 soundings both within and just outside the Opet Temple, abundant cultural material – presently under study – was uncovered, including shells, lithics, stone beads, ceramics, seal impressions, as well as faunal remains. Except for surface fills and modern pits, all layers from the soundings were sieved – with an 8mm diameter mesh. A smaller sieve (5mm mesh size) was frequently used for sandy-silt and ashy layers.

The excavations of the courtyard Opet Temple yielded a total of 5234 animal remains and 91% of these (n=4761) belong to Middle Kingdom occupations to the early New Kingdom (henceforth MK–early NK; XIth–XVIIIth dynasties, ca. 2100–1400 BC),¹ which is the reason our study will focus almost exclusively on these periods. Levels

1–3 (XIth–XIIth dynasties) comprise a succession of thin horizontal occupation layers – floors and/or household rubbish dump, although the fauna from level 4 comes mainly from the homogeneous filling of deep foundation pits with mixed MK–early NK material (Table 26.1). The upper levels (5–9) provide interesting insights into the later period, but their examination cannot be considered relevant for a comprehensive study due to mixing of deposits.

Table 26.2. Species list count recovered from the courtyard Opet temple excavations (Occ = occupations; Fil = filling).

AGE	Middle Kingdom to early New Kingdom						Late epoch to modern period					
Archaeological Period	1	2	3	4	Total		5	6	7	8/9	Total	% total
Context	Occ	Occ	Occ	Fil	N	%	Fil	Temple	Temple	Pit		
<i>Consumed species</i>												
Sheep/Goat (<i>Ovis aries</i> / <i>Capra hircus</i>)	16	35	29	123	203	4.3	1	20	11	12	247	4.72
Cattle (<i>Bos taurus</i>)		28	20	81	129	2.7	3	16	4	1	153	2.92
Pig (<i>Sus scrofa</i> dom.)	5	80	5	50	140	2.9	3	5	3	1	152	2.90
Pisces	2	39	17	66	124	2.6	1	7	1	2	135	2.58
Aves sp.	1	2	2	4	9	0.2	1	2	1		13	0.25
<i>Various status</i>												
Donkey (<i>Equus asinus</i>)		2			2	–				1	3	0.06
Dog (<i>Canis familiaris</i>)		2	2		4	–					4	0.08
Rodents (<i>Gerbillus</i> sp./ <i>Arvicanthis niloticus</i>)		1	2	30	33	0.7	2	17			52	0.99
<i>Unidentified mammalian remain</i>												
Caprini size	34	72	13	183	302	6.3	20	22	1	6	351	6.71
Cattle size	2	31	4	41	78	1.6	1	20		1	100	1.91
Unknown size	144	1019	413	2161	3737	78.5	31	151	21	84	4024	76.88
Total	204	1311	507	2739	4761	–	63	260	42	108	5234	–
% Total	3.90	25.05	9.69	52.33	100	100	1.20	4.97	0.80	2.06	–	100

In this imperfect methodological context with small sample sizes, the amount of bones collected still constitutes an interesting first reference point for our knowledge of the ancient fauna of the late 3rd–mid-2nd millennium BC.

The faunal list

Among the totality of the collection of the faunal remains, 14.5% (759 elements) could be identified with some certainty to species (Table 26.2). The three main domesticates, caprids (sheep/goat), cattle and pig, made up 72.7% of the identified material. Except for the short bones, that are more robust and compact, such as the carpals, tarsals and phalanx, all bones are fragmented into many pieces, especially the long-bones. Consequently, 4471 bones could be identified only to body size group: (1) small size (caprid/young pig), (2) large size (large pig/ cattle) and (3) unknown size (splinter). No worked bones and no wild ungulate species such as gazelle (*Gazella*) or Barbary sheep (*Ammotragus*) were recovered from the site. Beside the mammal bones, 135 remains belong to Nile fishes and 13 to wild birds were identified. This ratio is almost the same for MK–early NK material

with 472 bones (73.3% of the identified material) for the main domesticated species (Table 26.2).

State of bone preservation

The bones show few signs of weathering processes suggesting that they were not exposed on the surface for very long. No connective tissue or articulated bones (complete joints) were found among the deposit. Most of the bones remains of levels 1 and 2, the older occupations not so far from the Nile water level, are covered by carbonated concretions, which affected the bones surface after their burial. This mineralisation results from water circulation through the deposits.

Around 25% of the identified bones and 40% of the unidentified material are burnt, sometimes intensely calcined. The examination of the colour and the macroscopic appearance shows that a great majority of bones are black (stages 2–3) while few are white (stage 6) the latter representing very high temperatures (Nicholson 1993; Stiner *et al.* 1995).

Consumed species: the classic domesticates (cattle, sheep/goat, pig)

Sheep/goat

Despite published criteria for separating *Ovis* and *Capra* (Boessneck *et al.* 1964; Payne 1985; Prummel & Frisch 1986; Helmer 2000; Fernandez 2001; Halstead *et al.* 2002), the anatomical distinction between them when studying bone fragments is difficult, particularly when they are butchered, cooked, and exposed to soil for millennia. The presence of some well-preserved elements like the talus, humerus or ulna, permitted clear identification of goats, suggesting that they were much more common at Karnak, than at most Egyptian sites where sheep predominate (e.g. Kom el-Hisn, Lehner, Ibrahim Awad, Merimde; Redding 1992) or as in the Middle East in general (Redding 1985). While sheep would have competed with cattle for floodplain grazing area, goats would have subsisted on poor-quality vegetation along the desert edge (Rossel 2006).

According to the diagrammatic representation of wearstate in the 3rd milk molar (dP4) (Payne 1973; 1985), the deciduous teeth (one lower dP3, nine lower dP4, one upper dP3, three upper dP4: 14/91 = 15.4%) clearly show predominance of young adults 1–2 years old. This result is confirmed by the presence of unworn teeth (three

lower molars and two upper molars). Only one mandible belonging to the level 3 and one upper M¹ from level 1 attest to the presence of old individuals. Therefore, for the MK–early NK period, we observe approximately 50% lambs/kids, 20% young adults (teeth not worn), 23% mature and 7% old individuals. No yearlings were found in the assemblage. According to caprine-management within the present-day herding systems in the southeast of France (Blaise 2005; Helmer *et al.* 2007), such a choice corresponds with the consumption of young males for tender meat at the maximum weight. This profile was found notably during the Bronze Age in many Predynastic Egyptian sites (Van Neer 2002), or in the northern Near East, as at Sheik Hassan (middle Uruk period, Syria) and southeastern France (Vila 1998; Helmer *et al.* 2007).

For caprids, the whole skeleton is represented (Table 26.3) with a higher proportion of skull (isolated teeth) elements (n=124, 54.2%) and feet elements (carpals, tarsals, metapodials phalanx and sesamoids, n=70, 28.2%). The axial skeleton (ribs and vertebrae) are under-represented (4.5%), but if we take into account elements placed in the caprid size category (with respectively 30.5% of the elements), we obtain more coherent results (35%). The forelimb (6%) and the hindlimb (5.5%), rich meat elements, are scarce and the long-bones diaphyses – whether determined or not – are more plentiful than the extremities. Only ten bones exhibit unfused epiphysis (two distal radius, four calcanei, one femora distal and one 2nd phalanx) or juvenile aspect (two astragali), although this is not a large enough sample to construct a survivorship curve age distribution.

Table 26.3. Skeletal parts of domesticated mammals in NISP (Number of Identified Specimens) and % of NISP from the courtyard Opet temple excavations. (M.K. to N.K. = Middle Kingdom to early New Kingdom period; L.E. to R.P. = Late Epoch to recent period according to Table 26.1).

	CAPRID				CAPRID SIZE				PIG				CATTLE				CATTLE SIZE			
	M.K. to N.K.	%	L.E. to R.P.	%	M.K. to N.K.	%	L.E. to R.P.	%	M.K. to N.K.	%	L.E. to R.P.	%	M.K. to N.K.	%	L.E. to R.P.	%	M.K. to N.K.	%	L.E. to R.P.	%
	NISP		NISP		NISP		NISP		NISP		NISP		NISP		NISP		NISP		NISP	
Cranium	6	3.0	1	2.3	9	3.0	--	--	3	2.1	--	--	13	10.1	1	4.2	7	9.0	--	--
Mandible	13	6.4	--	--	4	1.3	--	--	9	6.4	--	--	13	10.1	1	4.2	--	--	--	--
Isolated Teeth	91	44.8	13	29.5	--	--	--	--	91	65.0	5	41.7	57	44.2	4	16.7	--	--	--	--
CRANIUM	110	54.2	14	31.8	13	4.3	--	--	103	73.5	5	41.7	83	64.4	6	25.1	7	9.0	--	--
Vertebra	6	3.0	--	--	32	10.6	8	16.3	--	--	--	--	8	6.2	5	20.8	12	15.4	2	9.1
Rib	3	1.5	2	4.5	60	19.9	16	32.7	--	--	--	--	11	8.5	--	--	16	20.5	7	31.8
TRUNK	9	4.5	2	4.5	92	30.5	24	49.0	--	--	--	--	19	14.7	5	20.8	28	35.9	9	40.9
Scapula	4	2.0	--	--	11	3.6	5	10.2	--	--	--	--	3	2.3	--	--	1	1.3	--	--
Humerus	3	1.5	2	4.5	10	3.3	2	4.1	2	1.4	1	8.3	--	--	--	--	--	--	--	--
Radius-ulna	5	2.5	3	6.8	2	0.7	1	2.0	2	1.4	--	--	2	1.6	1	4.2	1	1.3	--	--
FORELIMB	12	6.0	5	11.3	23	7.6	8	16.3	4	2.8	1	8.3	5	3.9	1	4.2	2	2.6	--	--
Pelvis	1	0.5	--	--	4	1.3	--	--	--	--	--	--	1	0.8	1	4.2	--	--	--	--
Femur	4	2.0	--	--	4	1.3	2	4.1	--	--	--	--	1	0.8	2	8.3	--	--	--	--
Patella	1	0.5	--	--	--	--	--	--	--	--	--	--	1	0.8	--	--	--	--	--	--
Tibia	4	2.0	--	--	1	0.3	1	2.0	--	--	1	8.3	--	--	2	8.3	1	1.3	--	--
Malleolus	1	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HINDLIMB	11	5.5	--	--	9	2.9	3	6.1	--	--	3	2.4	5	20.8	--	--	1	1.3	--	--
Carpal	5	2.5	--	--	--	--	--	--	--	--	--	--	2	1.6	1	4.2	--	--	--	--
Metacarpal	3	1.5	--	--	--	--	--	--	1	0.7	1	8.3	--	--	--	--	--	--	--	--
Astragalus	10	4.9	--	--	--	--	--	--	1	0.7	1	8.3	--	--	--	--	--	--	--	--
Calcaneus	6	3.0	--	--	--	--	--	--	--	--	--	--	1	0.8	--	--	--	--	--	--
Others tarsal	1	0.5	--	--	--	--	--	--	8	5.7	--	--	1	0.8	--	--	--	--	--	--
Metatarsal	8	3.9	7	15.9	--	--	--	--	--	--	--	--	1	0.8	--	--	--	--	--	--
Metapodial	12	5.9	3	6.8	1	0.3	--	--	7	5.0	--	--	4	3.1	--	--	--	--	--	--
Phalanx 1	3	1.5	1	2.3	--	--	1	2.0	5	3.6	1	8.3	4	3.1	--	--	--	--	--	--
Phalanx 2	5	2.5	1	2.3	--	--	--	--	10	7.1	--	--	2	1.6	2	8.3	--	--	--	--
Phalanx 3	3	1.5	1	2.3	--	--	--	--	1	0.7	2	16.7	--	--	--	--	--	--	--	--
Sesamoids	1	0.5	--	--	--	--	--	--	--	--	--	--	2	1.6	--	--	--	--	--	--
FEET	57	28.2	13	29.6	1	0.3	1	2.0	33	23.5	5	41.6	17	13.4	3	12.5	--	--	--	--
Long bone	4	2.0	10	22.7	164	54.3	13	26.5	--	--	--	--	2	1.6	4	16.7	40	51.3	13	59.1
Burnt Bone	60	29.6	15	34.1	102	33.8	27	55.1	31	22.1	4	33.3	31	24.0	6	25.0	30	38.4	10	45.4
Total	203	100	44	100	302	100	49	100	140	100	12	100	129	100	24	100	78	100	22	100

Cattle

Maxilla, mandible and tooth fragments are the most numerous cattle remains (64.4% of all cattle skeletal elements) followed by the trunk (14.7%, and increase at 22.7% with the cattle sized elements) and the feet extremities (13.4%). In contrast for caprids, the rich meat parts of the skeleton, the forelimb and the hindlimb, are rare with 3.9% and 2.4 % respectively. The presence of two unerupted molars, of one unworn lower M₃, of one upper dP⁴ and of one mandible with the M₂ in the crypt indicate the presence of calves or young adults. Only one complete mandible (level 5) testifies to the presence of a mature individual. Finally two bones had unfused epiphyses, a distal radius epiphysis (level 2) and a distal femur condyle (level 6). These two bones fuse around 3.5 years (Barone 1986).

Pig

With 152 elements, pig remains constitute a large proportion of the mammalian faunal remains. Like the caprid and the cattle, pig is represented mostly by skull remains with isolated teeth or enamel fragments (n=108, 71% of identified skeletal elements) and feet elements (n=38, 25%). Trunk and hindlimb elements are absent while the forelimb was represented only by four remains, two humeri and two radio-ulnae. As indicating the presence of burnt traces, on teeth, the abundance of enamel fragments is the result of the explosion of teeth when burnt. It is also very difficult to establish the kill-off pattern, because very few complete teeth are present. Nevertheless, we can note the presence of six fragments representing incompletely formed teeth, with open roots, and one mandible and one maxilla with deciduous teeth, evidence for piglets (Rowley-Conwy

1993). As such in Karnak like elsewhere, domestication is assumed in a context where there is large percentage of piglet bones, showing a systematic and regular culling, contrarily to hunters of wild boar which usually create bone assemblages comprising older animals (Lobban 1998). Abundant pig bones were mentioned in the excavations at Karnak to the east of the Sacred Lake beyond the outer wall of Tuthmose III (Debono 1982).

Before the appearance of the Judaic or Islamic taboo, one can see a long history of negative images and roles for pigs in Egypt. As A. J. Cagle says (Cagle 2002):

'The role of the pig (*Sus scrofa/Sus domesticus*) in the diet of ancient Egypt has been somewhat confusing for one simple reason: there is an almost total absence of pig remains from tomb provisions and a similar dearth of pictorial and textual representations from tomb and temple contexts. The main reason cited for this absence of evidence is mythological in nature: the male pig was often a manifestation of the evil god Seth and was thus considered a ritually unclean or impure animal much as it is today among various religions'. (see also Newberry 1928; Malaise 1988; Redding 1992; Lobban 1998)

The minor species: donkey, dog and rodents

Beside the domestic species, remains belonging to dog (n=4), donkey (n=3) and rodents (n=52) were identified.

Dog (*Canis familiaris*) is attested by the presence of teeth and may have been used for guarding, hunting or as a companion, but they could also have been used for cleaning the environment. In many rural communities dogs live essentially on garbage, and packs of pariah dogs too were a menace in towns and villages (Dixon 1989).

Three remains of donkey (*Equus cf. asinus*) were observed. The talus found in US 168159 (level 9) is clearly sub-recent, but the sesamoid and the phalanx III found in the level 2 are contemporaneous with the first phase occupation of the site. The donkey was the most important load carrier in Ancient Egypt, attested already in the Maadi Period (Predynastic period). It was used for ploughing the seed into the ground. Donkeys were also used to carry people (Blench 2000; Rossel 2006).

The rodents, essentially gerbils (cf *Gerbillus* sp.) and the Nile rat (cf *Arvicanthis niloticus*), constitute intrusive species. The presence of these two species is attested in the majority of archaeological sites in Egypt where sieving was undertaken. The Nile rat lives near houses and is at present considered in Egypt as the most harmful rodent species because of the damage it causes to agriculture. Gerbils (the species represented at the Opet cannot be identified), live generally in sandy places of semidesert regions, containing a minimum of natural vegetation or cultures. Moreover the Theban necropolis was overrun

by rodents which wriggled down through every crack and crevice to gain access to the food offerings placed with the dead; and in virtually every house in the Middle Kingdom workers' town at Kakhun the corners of the rooms had been tunnelled through by rodents (Dixon 1989, 194–195)

Table 26.4. Fish taxa present on the Opet Temple courtyard excavations (identification: Wim Van Neer, Natural History Museum, Brussels).

<i>Family</i>	<i>Species</i>	<i>Common Name</i>	<i>Anatomical Elements</i>
Clariidae	<i>Clarias</i> sp.	Catfish	Pectoral spine, cranium roof fragment, vertebrae, urohyal, articular
Mochokidae	<i>Synodontis</i> sp.	Catfish	Several pectoral spines
Mormyridae	<i>Hyperopisus</i> sp.	Elephantfish	Dentary
Latidae	<i>Lates niloticus</i>	Nile Perch	Anal pterygiophore
Bagridae	<i>Bagrus bajad</i>	Bayad (catfish)	Ceratohyal
Cichlidae	Tilapiini		Dorsal spine, 1st vertebra, 3rd vertebra
Cyprinidae	cf <i>Barbus-Labeo</i>		Precaudal vertebra

Nile fishes (identified by Wim Van Neer, Natural History Museum, Brussels)

One hundred and thirty-five fish remains were identified in the faunal assemblage, representing the major fish taxa that are encountered in the ichthyofaunal record of Egyptian sites (Van Neer 2004). In spite of the fragmentation of the bones and the presence of numerous vertebrae, for which the generic attribution is often difficult to establish, certain diagnostic pieces permitted the identification of several taxa (Table 26.4). The Clariidae – catfish – are well represented in the site. Two genera are found in the Egyptian Nile, *Clarias* and *Hetrobranchus*, but only the first one was determined with certainty based on the pectoral spine (Gayet & Van Neer 1990). Identification to species is only possible based on the entire vomer bone, an element absent in the Opet sample (Gautier & Van Neer 1989). Several

pectoral spines allow us to identify *Synodontis*, but it is still difficult, without more diagnostic elements (i.e., the cleithra) to determine which species is present at the site. The other fishes identified in the studied area are *Bagrus bajad*, as well as *Tilapia* (tribe Tilapiini), Cyprinids (mainly *Barbus bynni*, sometimes *Labeo*) and the Nile perch (*Lates niloticus*).

The aforementioned taxa, which usually represent more than 90% of the fish bones in Egyptian archaeological sites, can be subdivided into two ecological groups, namely 'floodplain dwellers' and 'open water taxa' (Van Neer 2004). The floodplain dwellers are fish that prefer shallow environments and that can survive in adverse conditions. This group comprises the Clariidae that have accessory breathing organs, which enable them to use atmospheric oxygen. The Tilapiini and cyprinids also belong to this group; they do not have accessory respiratory organs, but their haemoglobin has a high affinity for dissolved oxygen (Fish 1956). The open water species typically spend most of their life in the main river and include Nile perch and the catfish genera *Bagrus* and *Synodontis*. As such the presence of bones from these larger fishes indicates harpoon, spear or net fishing from boats.

Birds

Thirteen wild/domesticated bird remains, of which nine belong to the MK–early NK period, were recovered in the bone assemblage and none of them could be identified to species as they represented fragments of long-bone diaphysis or of skull. If birds, such as geese, ducks and pigeons constituted an important source of the lists of funeral offering (Darby *et al.* 1977), it was not rare to find numerous breed fowls, captured or bought in villages as for instance in Deir El-Medineh (Malaise 1989).

Zooarchaeological interpretation

Few stratigraphic differences are evident between the different levels in the species and manner in which animals were consumed for the MK–early NK period. Caprines dominated, followed by pigs and cattle in equal proportions. The observed differences in some archaeological levels are essentially connected to the larger numbers of small easily recognizable dental fragments which have increased the NISP counts (for example for the pig in the levels 2 and 5) or connected simply to the size of the sample which is bound to the volume of deposit excavated in various soundings. Nevertheless, the body part representation (Table 26.3) is similar between the three domestic

species: the rich parts in meat are even under-represented relative to the parts poor in meat such as the head or the extremities of the legs.

To explain this skeletal representation, we cannot call upon diagenesis or the presence of foundation deposits or offering for the reasons evoked above. Rather, the bones appear to represent cooking waste abandoned after treatment and consumption of carcasses. Indeed, the extremities of legs and crania are not preferentially consumed food, despite the fact that people like to eat brain or tongue.

Burned bones are present in all archaeological levels (Table 26.3). All the skeletal parts are affected by fire, but it is especially the fragments of long-bone diaphyses, vertebrae and ribs that increase the percentage of burned bones. The largest bone splinters are not completely burnt, but exhibit scorched areas due to fire, which, suggests that bones were in contact with fire during the preparation of the meat, such as during the roasting. Another explanation would be that the bones accidentally burned after being disposed of or even that they were intentionally burnt as garbage.

Lastly, one bone (a *Bos* size rib fragment) presents cut marks, but many pieces show clearly intentionally bone break (slicing marks, for meat preparation or marrow extraction) were present on the bone material, showing butchering damage. Gnaw marks made by rodents or carnivores were rarely seen in the sample: only four bones exhibited signs of carnivore (dog?) damage and an additional one may have been gnawed by a rodent. This suggests that the remains were rapidly buried.

Conclusion

Due to a complex sequence of occupation and to small sample sizes, the zooarchaeological analyses previously described allow only a partial reconstruction of the lifestyle of the inhabitants of Karnak during the Middle Kingdom up to the Early New Kingdom at the current temple of Opet. Sheep and goat were widely consumed, and in to a lesser degree cattle and pig. They were suppliers of meat, and the absence of an important number of adult means a limited exploitation of the secondary products (milk, wool, etc). The presence of numerous young adults among the domestic animals, associated with numerous remains of fishes, would show that the present occupations on the place of Opet, not so far from the divine domain of Amun-Ra, would be connected to an administrative zone with strong agricultural and craft connotation as the first results of the lithic industry suggests

(Raphaël Angevin, pers. comm. 2008) and underlines the fact that the inhabitants were low-ranking consumers (city-dwellers) or granary staff, and not breeders. The absence of wild game common in some Predynastic sites (Boesneck 1988; de Miroschedji *et al.* 2001, Van Neer 2002) among the Opet assemblage could have three main explanations: 1. with the intensification of agriculture on the floodplain and heavy hunting during the Predynastic period, wild animals disappeared with their habitat; 2. the urban context of the first occupations in Opet or; 3. the food remains in this sample represent low status food waste, hunted animals may have been luxury items at this time.

The low frequency of cattle would be explained by the fact that these animals were under the control of a central authority, with for instance the presence of cattle rearing in some places, such that they are commonly found on offerings lists and tables or in foundation deposits (Weinstein 1973; Redding 1992; Bartosiewicz 2000; Rossel 2006). The low number of pig bones indicates no reliance on pig. Redding (1992) argued that in the subsistence system of ancient Egypt the pig was not transported or manipulated by a central authority. Instead, the pig functioned as a locally maintained, inexpensive resource that an individual family could rear to supplement other sources of protein. But, the pig in Ancient Egypt is incompatible with intensive production of grains; hence at the site or in the area, as involvement in wheat/barley agriculture increases the use of pigs would decline (Redding 1992, 104). Finally, fish represented an important part of the Theban supplies, like a staple food, because the animals seasonally occur in large numbers on the floodplain and were intensively exploited. Moreover fish could be easily dried for future consumption (Van Neer 2004).

This zooarchaeological study provides another insight into Theban life and offers a deeper appreciation of the sacred domain of Amun during the late 3rd–mid-2nd millennium BC.

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Note

1 Xlith dynasty belongs to both late First Intermediate Period and early Middle Kingdom. It is here included in the Middle Kingdom period to simplify our discussion.

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27. More animal burials from the Predynastic elite cemetery of Hierakonpolis (Upper Egypt): the 2008 season

Wim Van Neer, Veerle Linseele & Renée Friedman

Three animal burials from the Predynastic elite cemetery HK6 at Hierakonpolis are described. Recent excavations at this site have revealed large tomb compounds and a precinct of funerary temples dating to the Naqada IC–IIB (ca. 3800–3600 BC), all of which included animal burials. Shallow pits discovered by the enclosure wall of the cemetery and near the northeast corner of the temple precinct yielded the articulated skeletons of nine dogs, a baboon and six cats. A description of the finds is provided and special attention is given to the size reconstruction and possible breeds of the dogs, the pathology seen on the baboon skeleton and its interpretation in terms of conditions of keeping, and the status of the cats (wild, tamed or domestic).

Keywords offerings, ritual, dog, baboon, cat, domestication

Introduction

Hierakonpolis (Kom el Ahmar, ancient Nekhen) (25°06'N, 32°46'E) is a major archaeological site located on the west bank of the Nile, 17km north of the modern town of Edfu in Upper Egypt (Fig. 27.1). Covering nearly 3km², it is the largest site of the Predynastic period (4000–3100 BC) still extant and accessible. At its peak at ca. 3700–3400 BC, it must have been one of the largest centres anywhere along the Nile and its desert sands preserve domestic areas, industrial zones, ceremonial centers and discrete cemeteries for the different strata of

society. Based on its size and other historical criteria, it is generally considered to have been the capital of a pre-unification southern kingdom in Upper Egypt (Hoffman 1982; Adams 1995; Friedman *et al.* 1999; 2002; Friedman 2008b).

Archaeological evidence to support its exalted status is currently being found in the cemetery of the elite segment of society called HK6, where recent excavations have uncovered two of the largest known tombs of the early Naqada II period (ca. 3800–3600 BC) and indications of the wooden superstructures that surrounded them. In addition, a distinct ritual precinct containing woodbuilt funerary temples, the earliest in Egypt, has also been discovered (Friedman 2008a; 2008b). Wide area clearance, with special attention to the recovery of architectural traces, has allowed the new and many of the older tombs excavated in previous campaigns in this cemetery (1979–1986 by Michael Hoffman; 1997–2000 by Barbara Adams) to be placed in a broader context. Results of the 2009 season of investigation indicate that large elite tombs of this period were placed at the center of an interconnected complex of fenced enclosures containing smaller subsidiary graves not only of (presumably) family members and court officials, but also a variety of animals, both wild and domestic (Friedman 2010).

Since the initial excavation in the 1980s (Adams 2000), the HK6 cemetery has been recognised as unique in the Predynastic period for the number and variety of animal taxa it contains. These take the form not only of butchered parts offered as food, but also, and more frequently, as complete carcasses often buried with care in tombs with or without human accompaniment (Fig. 27.2). Although the cemetery was mainly used during the Naqada IC–IIB (ca. 3800–3600 BC) and Naqada III periods (3300–3000 BC), the independent burial of animals appears to be a feature of the earlier phases only. The faunal material found during the 1979–2003 campaigns has been described in Van Neer *et al.* (2004) and includes both domestic (cattle, sheep, goat, dog, donkey) and wild species (anubis baboon, aurochs, hartebeest, wild donkey, hippo, elephant, jungle cat). Almost all of the tombs contain some faunal remains, but due to considerable disturbance and plundering in ancient and modern times, the locus of primary deposition of some of this material cannot always be determined with certainty.

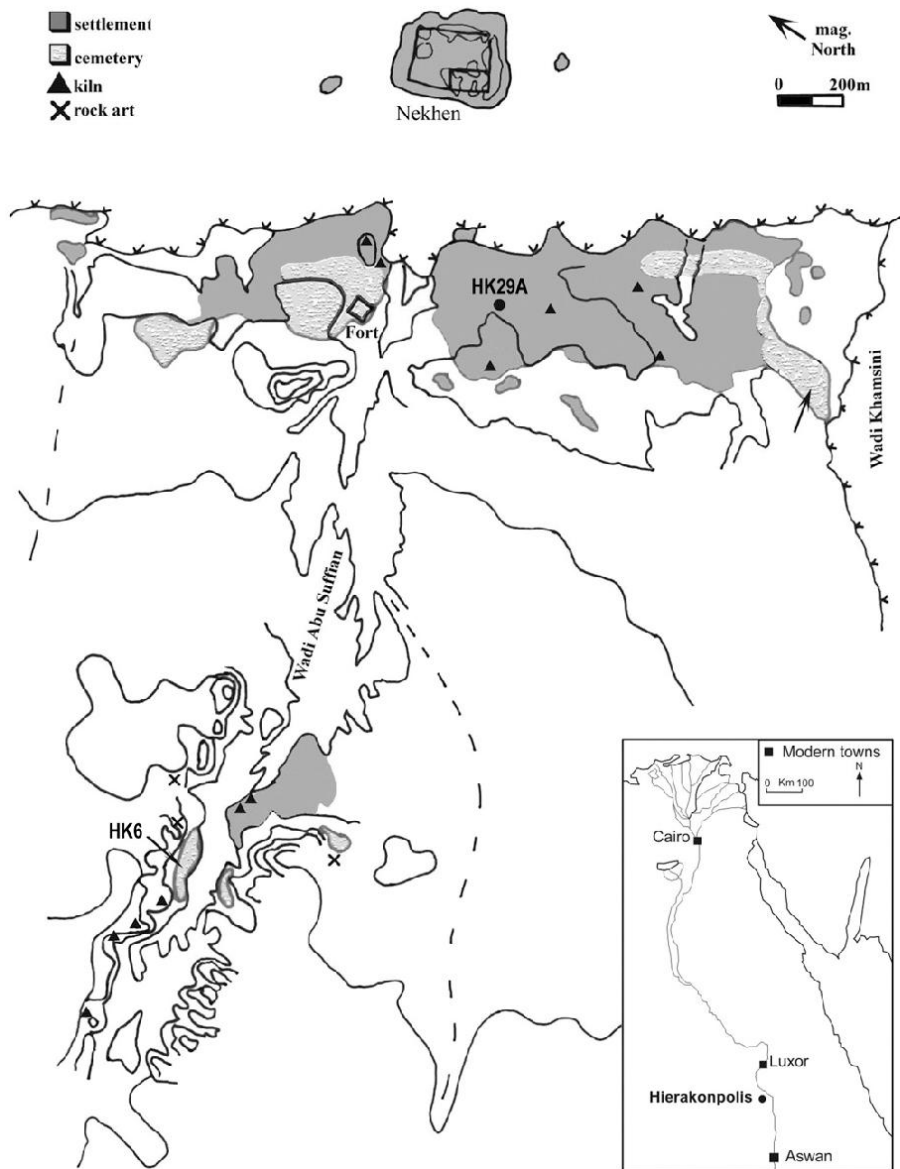


Fig. 27.1. Hierakonpolis and its localities mentioned in the text.

The present contribution deals with the animal burials discovered in March 2008 when investigations were focused on determining the extent of the funerary temple or ‘pillared-hall’ precinct (Fig. 27.2). To that end, excavation was made along the northern course of a wood-post wall (Wall B7) that runs along at the edge of the wadi terrace on which HK6 is located. As the purpose was specifically to determine whether this wall turned a corner and enclosed the ritual precinct, a wide area to the west of the wall was also investigated. The

excavation along 25m of this wall revealed no corner; however, on the west side of this wall, in grid square B11, a deflated and rocky area otherwise almost entirely devoid of finds, three subsurface pit features were discovered which contained the first undisturbed burials of animals found in this cemetery. Feature B was the shallow grave of a juvenile baboon; feature C, an oval pit containing nine dogs; and feature E, a small circular pit with the articulated skeletons of six cats. All of the burials were intact, but none contained artefacts. Placed in close proximity to each other, the burials are almost certainly contemporary. Based on their position beside the wall, which can be dated to early Naqada II by materials in its foundation trench, it is assumed that the animal burials date to the same period. No material of later date was found in the immediate vicinity (Van Neer & Linseele 2008; Friedman 2010).

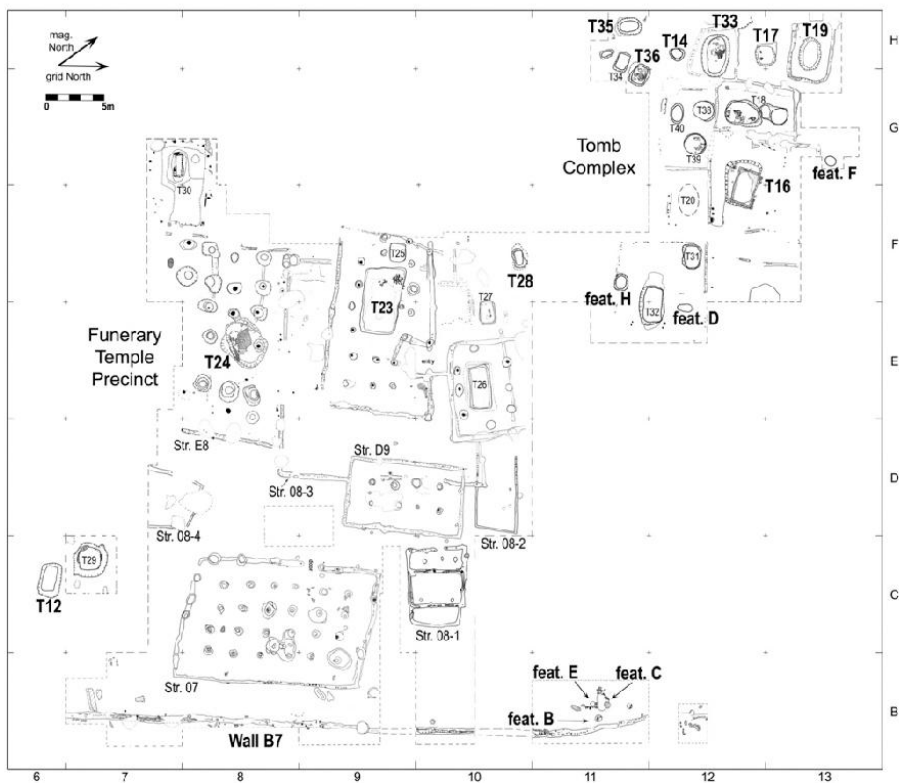
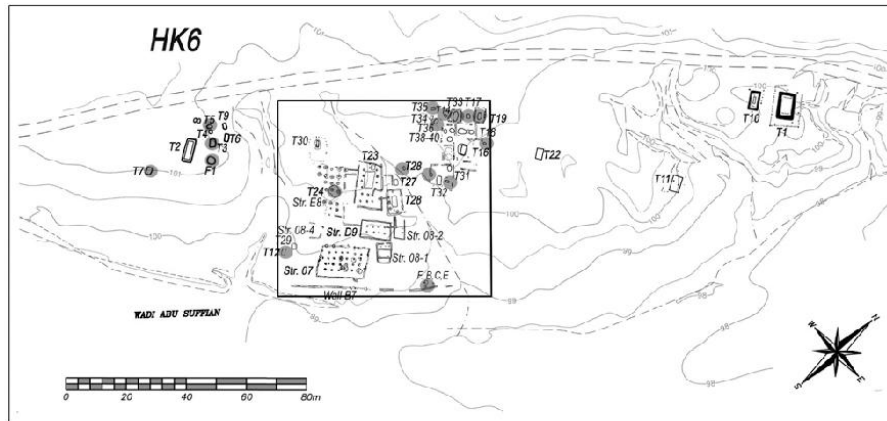


Fig. 27.2. Map of the cemetery at HK6 with tombs containing animal burials indicated in grey, and detailed plan of the funerary temple precinct and tomb complex investigated in 2000–2009.

Description of the animal burials

The young baboon in feature B

In a shallow pit immediately below the present surface, and less than 30cm from the foundation trench for wall B7, a baboon was found, lying on its right side, facing north (Fig. 27.3). The animal was more or less in a foetal position, with its legs flexed upward and the lower arms resting on the knees.

The skull was poorly preserved, chalky and fragile, as a result of subsurface weathering and therefore a secure identification as either anubis (*Papio anubis*) or hamadryas baboon (*Papio hamadryas*) could not be achieved. However, it is likely that it is an anubis baboon since all individuals from HK6 that could be specifically identified thus far belong to this species (Van Neer & Linseele 2002; Van Neer *et al.* 2004). A secure sex identification of the individual was also not possible, since no observation of the canines could be carried out, not even during the excavation due to weathering.

Both the dentition and the fusion state of the long bones provide information allowing an age estimation of this individual. In the jaws, the second molars have attained the occlusal level, but they do not yet show any wear. The majority of the long bones of which the ends are preserved do not have their epiphyses fused to the shafts. This is the case for the proximal radius, the proximal and distal ulna, the proximal and distal femur, the proximal and distal tibia, the tuber of the calcaneus, the distal metapodials, and the proximal 1st and 2nd phalanges. The distal humerus, however, was already fused, a process that is terminated at about 3 years of age in females and 4 years of age in males (Bramblett 1971). Most of the other epiphyses mentioned above, that were not yet fused, do so between 6 and 7 years of age. Wear of the lower 2nd molar starts around 5–5.5 years of age. Taking these ageing criteria into account, it can be concluded that the baboon must have been older than 3 years and younger than 5.5 years, and most probably between about 4 and 5 years of age. Because of the young age of the animal and the poor preservation of its skeleton, the number of measurable bones was rather limited (Table 27.1).

Despite the brittle nature of the skeleton, it was possible to detect at least one pathology on the long bones. The lower third of the left ulnar shaft shows a transverse fracture, but the radius is intact over its whole length (Fig. 27.3). Above and below (i.e., proximal and distal of) the fracture, the shaft is swollen, but there is no evidence for the formation of a callus that unites both parts. This pathology is reminiscent of one observed previously in a baboon from Tomb 12, also in the HK6 cemetery. That burial contained seven anubis baboons exhibiting numerous pathologies related to traumas that the animals underwent (Van Neer & Linseele 2002; Van Neer *et al.* 2004). On the

right ulna of one of these baboons was a fracture at the same level as that on the specimen from feature B (Fig. 27.4). In this case as well, a pseudoarticulation developed, probably as a result of the lack of immobilisation during callus formation. The young, female baboon of about 4 years of age found Tomb 17 in the HK6 cemetery also had a pathological forearm: the distal third of the shaft of the left radius and ulna are thickened over a length of about 4cm. As a result of this swelling the two bones are in contact and a synostosis was forming.

Table 27.1: Measurements (mm) on the baboon from feature B.

lower M2, GL	14.0
atlas, GB	38.6
atlas, H	22.5
humerus, Bd	35.1
tibia, GL shaft	151
calcaneus, GL without tuber	44.2
astragalus, GL	29.4

Dynastic depictions of constrained baboons or other cercopithecids show a rope tied either around their waist or neck (Osborn & Osbornová 1998), making it unlikely that the observed fractures of the forearms are related to the tethering of the animals. In humans, this type of forearm trauma has been called a ‘parry fracture’ and it is often seen as a result of interpersonal violence, although other causes, such as accident, stress, fatigue, or an underlying pathological condition are also possible factors (Smith 1996). These ‘nightstick’ or ‘defense’ fractures can occur when the forearm is used to parry or deflect blows to the head; however, it is unclear if this explanation also serves for the HK6 baboons. No cranial injury was observed on the feature B specimen or on the single more or less completely preserved skull that was found in Tomb 12. A mandible from that tomb had a healed fracture of the right horizontal ramus, but when this trauma occurred – during capture or later on in captivity – cannot be established. The same uncertainty applies to the ulnae of the baboons in feature B, Tomb 12 and Tomb 17: are their fractures related to accident or violence? There are numerous traumatic lesions on the feet and hand bones of the Tomb 12 baboons: at least four out of the seven baboons had a fractured hind foot and at least five out of seven had a fractured forefoot. These types of fractures are more likely to have occurred when the animals were held in captivity and thus show that the baboons were subjected to violence, possibly of a disciplinary nature.

Nine dogs in feature C

Less than half a metre from the baboon burial another pit was

encountered beneath a loose pile of sandstone slabs. The oval pit, measuring roughly 1.4m east–west by 1m north–south and approximately 46cm deep, contained nine articulated dogs (Fig. 27.5). All the animals were on their left sides and oriented in the same direction with their heads to the east. The feet and legs were all directed southward, and many of these extremities were curved up along the southern side of the pit. This orientation of the skeletons shows that the dogs had been placed in the pit from the southern side. Observation during excavation of the relative positions and the superimpositions of the bones allowed the order in which the animals had been deposited to be reconstructed (Fig. 27.6).



Fig. 27.3. Burial of the young baboon (Feature B). The fractured part of the left forearm is indicated with an arrow.

Dog 9 was deposited first, on top of it came dogs 7 and 8, but in what order those two were cast in is unclear. Similarly it was not possible to establish in which order Dogs 6, 5 and 4 were deposited on top of dog 8. Dog 3 was placed in the pit after dog 6. Dog 2 was put on top of Dog 3 and the last animal deposited in the pit was Dog 1. During the excavations, when all of the individuals had been exposed, it appeared as if the animals had been laid along the bottom and around the sides of the pit since the upper, central part of the pit contained only sediment. It is likely, however, that the nine dogs

initially filled the entire pit cavity, and that the 'empty space' above was only a result of the compaction of the corpses during and after their decomposition. Evidence for such movements is provided, for instance, in dog 1 by displaced ribs that were no longer articulating with their corresponding thoracic vertebrae.



1 cm

Fig. 27.4. Right ulna with a pseudoarticulation from a baboon of Tomb 12.

Table 27.2: Measurements (mm) of the axial skeleton of the dogs. For the skull and mandible, numbers refer to those used by von den Driesch (1976). Measurements in brackets are approximate.

	<i>Dog 1</i>	<i>Dog 2</i>	<i>Dog 3</i>	<i>Dog 4</i>	<i>Dog 6</i> <i>male</i>	<i>Dog 7</i>	<i>Dog 8</i>	<i>Dog 9</i>
<i>Skull</i>								
CBL	(164)	—	—	—	(159)	—	—	—
23	56.5	—	—	—	—	—	—	—
40	38.5	37.5	38.2	—	—	—	39.2	—
25	30.7	31.7	30.7	—	—	—	29.0	31
31	35.0	—	—	—	—	—	—	—
29	48.5	—	—	—	—	—	—	—
38	51.5	51.6	52.1	—	—	—	49.4	—
alv. L. P1–M3	—	—	—	—	62.5	—	—	—
alv. L. P1–4	—	—	—	—	33.6	—	—	—
alv. L. M1–3	—	—	—	—	30.2	—	—	—
<i>Mandible</i>								
1	119	—	119	—	119	—	115	118
2	119	—	118	—	119.5	—	115	119
18	47.2	—	45.3	—	51.8	—	48.7	—
alv. L. P1–M3	61.5	—	67.8	—	64.4	—	61.8	65.8
alv. L. P1–4	33.8	—	—	—	33.4	—	32.9	35.8
alv. L. M1–3	29.0	—	36.4	—	29.8	—	28.5	30.9
7	67.5	—	—	—	—	—	—	—
GL M1	18.9	—	19.0	—	20.0	20.0	19.0	20.6
GB M1	8.0	—	—	—	7.8	7.7	7.5	8.3
GL M2	9.8	—	—	—	—	—	—	—
GB M2	6.2	—	—	—	—	—	—	—
20	15.0	—	—	—	—	—	—	—
19	19.4	—	—	—	—	—	—	—
<i>Atlas</i>								
GL	32.1	37.7	—	—	—	—	31.1	32.0
GB	—	67.6	—	—	—	—	—	—
BFcr	—	—	—	—	—	—	31.6	3.8
LAd	14.8	14.2	—	—	—	—	13.6	12.5
<i>Axis</i>								
H	34.5	30.1	—	—	—	29.7	—	30.1
LCDe	44.0	44.4	—	—	—	41.9	—	41.8
LAPa	42.3	47.4	—	—	—	45.4	—	40.0
BFcr	24.6	25.3	—	—	—	23.0	—	24.7
<i>Sacrum</i>								
GL	—	—	—	27	—	—	32.2	36.4
GB	—	—	—	31.7	—	—	34.2	38.8
PL	—	—	—	25.1	—	—	28.2	29.9
BFcr	—	—	—	17.9	—	—	18.3	20.4
HFcr	—	—	—	8.1	—	—	8.3	9.0



Fig. 27.5. View of the dog burial prior to the lifting of the individuals.

Associated with the skeleton of Dog 6 was a baculum, indicating that this animal was a male. Early in the excavation process, when Dogs 1 and 2 were lifted, a second baculum was retrieved from the 2mm sieve. Despite the systematic sieving of all the sediment from the pit, no additional bacula were found. Because of the rather fragile nature of this skeletal element and the generally poor bone preservation, it would be speculative to conclude that seven of the dogs were females. Measurements of the various elements of the dog skeletons are given in [Tables 27.2–4](#).

The age determination of the dogs can be carried out through combined use of dental and epiphyseal fusion data ([Table 27.5](#)). The mandibles of Dog 3 still have their deciduous canines, but these were in the process of being replaced by the permanent ones. This replacement takes place at around 5–7 months of age (Silver 1969). All of the other individuals have their complete permanent dentition in place, showing that these animals were at least seven months old. Dogs 4, 5 and 6 do not have all the epiphyses of their long bones fused and thus allow an age estimate on that basis. When the fusion state of the various bones within each of the individuals is considered, it appears that there are some slight contradictions within the scheme of Silver (1969). In Dog 4, for instance, the distal radius and ulna are not yet fused indicating that the animal was younger than 11–12 months, whereas the tuber calcis was already fused, a process that is terminated at 13–16 months of age. Nevertheless, it seems that Dog 4 and Dog 6 were around 1 year of age. Dog 5 was slightly younger, 8–9 months, judging from the distal humerus that is still fusing. Because the long bones of Dogs 1, 2, 7, 8 and 9 have all their epiphyses fused,

these individuals must have been older than 1.5 years of age (Silver 1969).

Table 27.3. Measurements (mm) of the shouldergirdle and anterior extremities of the dogs. Measurements in brackets are approximate.

	<i>Dog 1</i>	<i>Dog 2</i>	<i>Dog 3</i>	<i>Dog 4</i>	<i>Dog 6 male</i>	<i>Dog 7</i>	<i>Dog 8</i>	<i>Dog 9</i>
<i>Scapula</i>								
HS	—	—	—	106	—	—	—	—
SLC	—	—	20.2	17.3	—	—	19.3	19.5
GLP	24.2	24.2	23.8	22.0	24.7	23.5	22.1	24.4
BG	15.0	15.2	15.2	13.5	14.5	14.1	13.6	14.4
<i>Humerus</i>								
GL	134	139	—	<i>NF prox.</i> (133)	<i>NF prox.</i> (142)	139	132	140
Bp	25.5	24.9	—	21.3	24.5	25.0	23.0	26.6
Dp	32.4	31.6	—	29.0	—	31.6	30.0	34.2
SD	11.7	10.9	—	9.9	—	10.2	10.3	11.2
Bd	26.0	25.3	—	22.8	25.3	25.8	24.2	26.2
<i>Radius</i>								
			<i>NF prox.; NF dist.</i> (130)	<i>NF dist.</i>	<i>fusing prox.; NF dist.</i>			
GL	134	143	—	—	—	—	132	—
Bp	15.0	15.2	—	13.0	14.6	14.9	9.0	15.6
SD	9.9	10.3	—	—	—	—	10.1	9.7
Bd	19.4	19.5	—	—	—	—	17.7	20.2
<i>Ulna</i>								
				<i>NF dist.</i>	<i>NF dist.</i>			
GL	—	168.5	—	—	—	—	—	165
BPC	—	—	—	13.0	13.8	13.9	12.7	14.4
LO	24.2	—	—	23	26.3	23.9	22.6	24.7
SDO	16.9	18.1	—	15.5	17.1	16.7	16.2	17.3
DPA	20.2	21.1	—	18.1	20.5	19.4	17.8	20.0
<i>McI</i>								
GL	—	15.2	—	15.7	—	—	16.0	17.4
Bd	—	—	—	4.1	—	—	4.2	4.7
<i>Mc II</i>								
GL	48.0	47.2	—	45.4	47.3	—	50.8	47.5
Bd	6.6	7.7	—	7.0	7.7	—	6.4	7.2
<i>McIII</i>								
GL	54.5	53.5	—	51.6	55.0	—	44.1	53.6
Bd	6.9	6.8	—	6.7	6.6	—	6.6	7.0
<i>Mc IV</i>								
GL	53.8	52.2	—	50.5	55.6	—	49.8	53.5
Bd	6.8	7.6	—	6.3	6.5	—	6.2	6.8
<i>Mc V</i>								
GL	44.0	43.7	—	42.4	46.1	—	41.0	44.9
Bd	7.1	7.5	—	7.1	7.0	—	6.9	7.6

NF = non fused.

The problems that dog remains pose in age determination have been addressed by Horard-Herbin (2000), who developed a method for making age estimation on the basis of the occlusal wear of the lower 1st molar. When this scoring system is applied to the younger dogs, 3 and 6, it appears that the age estimations are less precise than (but in agreement with) the results obtained on the state of epiphyseal fusion. This method, however, was primarily devised to obtain more precise

age estimates for dogs with complete dentition and all their bones fused. The wear stages of the lower M1 indicate that Dog 1 was 2–4 years of age, Dog 8 was 3–4 years old and Dog 9 was a senile individual of more than 6 years of age. In the case of Dog 7, which should be older than 18 months because all of its long bones are fused, the wear stage of the lower carnassial suggests an animal of 6–15 months of age. This tooth had numerous fissures, which may be a possible reason why no wear facets could be detected and the dental age is underestimated.

Table 27.4: Measurements (mm) of the pelvic girdle and posterior extremities of the dogs. Measurements in brackets are approximate.

	Dog 1	Dog 2	Dog 3	Dog 4	Dog 5	Dog 6 male	Dog 7	Dog 8	Dog 9
<i>Pelvis</i>									
LA	–	–	–	–	–	–	–	17.1	18.8
<i>Femur</i>			NF prox.; NF dist. (145)			NF prox.; NF dist.			
GL	152	162		–	–	–	155	147	154
Bp	31.1	–	–	–	–	–	30.0	28.0	30.6
DC	15.7	–	–	–	–	–	14.8	14.3	16.0
SD	11.5	–	–	–	–	–	10.8	11.0	11.0
Bd	26.3	–	25.0	–	–	26.5	25.0	24.2	25.2
<i>Patella</i>									
GL	14.6	–	–	–	–	14.0	14.0	13.4	14.4
GB	9.0	–	–	–	–	–		–	–
<i>Tibia</i>				NF prox.; fusing dist. (155)		NF prox.; fusing dist.			
GL	154	159	–		–	–	151	148	155
Bp	28.7	28.6	–	26.2	–	28.7	28.3	27.1	29.2
SD	10.5	10.4	–	9.1	–	–	10.3	17.0	11.0
Bd	(18)	18.7	–	16.5	–	17.8	18.1	17.0	18.0
Dd	13.3	13.9	–	–	–	14.2	15.7	12.7	14.2
<i>Calcaneus</i>									
GL	38	35.8	–	34.7	–	38.5	35.5	34.0	35.5
<i>Astragalus</i>									
GL	22.4	22.0	–	20.8	20.5	21.9	22.0	20.5	21.3
<i>Mt II</i>									
GL	53.2	54.0	–	–	–	53.9	–	49.8	52.4
Bd	6.4	5.9	–	–	–	7.1	–	6.1	7.1
<i>Mt III</i>									
GL	61.0	59.7	–	–	–	61.4	–	56.0	58.9
Bd	6.8	6.8	–	–	–	7.3	–	6.4	6.5
<i>Mt IV</i>									
GL	62.5	58.0	–	–	–	63.0	–	56.7	60.5
Bd	6.6	7.0	–	–	–	6.6	–	6.5	6.7
<i>Mt V</i>									
GL	55.6	50.7	–	–	–	56.2	–	52.4	53.0
Bd	5.9	6.4	–	–	–	6.9	–	5.4	6.0

NF = non fused.

Table 27.5. Age estimations of the dogs. The epiphyseal closures are according to Silver (1969), and the dental wear stages according to Horard-Herbin (2000).

Element	Fusion at	Dog 1	Dog 2	Dog 3	Dog 4	Dog 5	Dog 6	Dog 7	Dog 8	Dog 9
Humerus distal	8–9 months	F	F	NF	F	fusing	F	F	F	F
Humerus proximal	15 months	F	F	NF	NF	NF	NF	F	F	F
Radius proximal	11–12 months	F	F	NF	F	NF	fusing	F	F	F
Radius distal	11–12 months	F	F	NF	NF	NF	NF	F	F	F
Ulna distal	11–12 months	F	F	?	NF	?	NF	F	F	F
Femur proximal	18 months	F	F	NF	NF	NF	NF	F	F	F
Femur distal	18 months	F	F	NF	NF	NF	NF	F	F	F
Tibia proximal	18 months	F	F	NF	NF	NF	NF	F	F	F
Tibia distal	13–16 months	F	F	NF	fusing	NF	fusing	F	F	F
Calcaneus tuber	13–16 months	F	F	?	F	?	F	F	F	F
Metacarpal distal	8 months	F	F	?	F	?	—	—	F	F
Metatarsal distal	10 months	F	F	?	?	?	F	—	F	F
Age based on epiphyseal fusion		>18 mo	>18 mo	<8–9 mo	≥12 mo	8–9 mo	≥12 mo	>18 mo	>18 mo	<18 mo
Dentition		complete	complete	canines replacing	complete	complete	complete	complete	complete	complete
Wear stage of M1		E/F	—	A/B	—	—	A/B	A/B	F	Gd
Age based on tooth wear		24–48 mo	—	6–15 mo	—	—	6–15 mo	6–15 mo	36–48 mo	>72 mo

F = fused; NF = non fused.

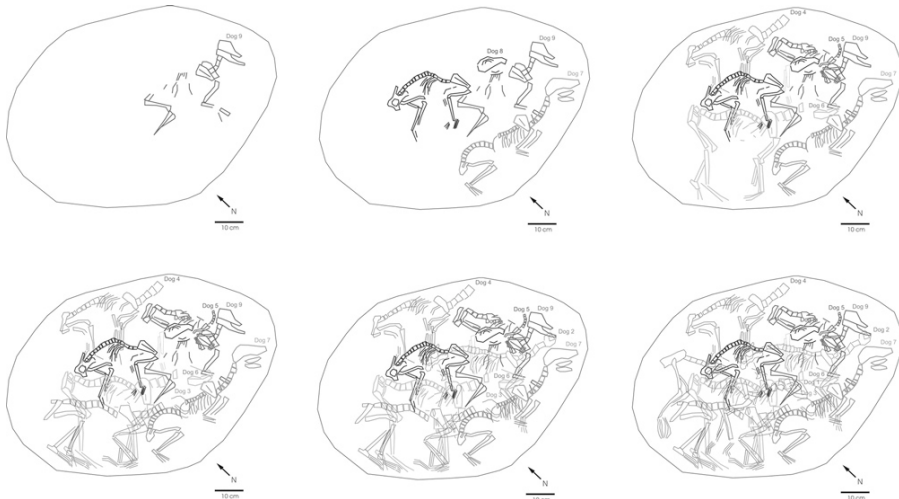


Fig. 27.6. A reconstruction of the various stages of the filling of the pit with indication of the numbers that were attributed to the dogs during the excavation.

Table 27.6: Size reconstruction of the dogs according to the different long bones.

	Dog 1	Dog 2	Dog 3	Dog 4	Dog 5	Dog 6	Dog 7	Dog 8	Dog 9
humerus	45	47	—	(45)	—	(48)	47	44	47
radius	43	46	(42)	—	—	—	—	43	—
ulna	—	45	—	—	—	—	—	—	44
femur	46	49	(44)	—	—	—	47	44	46
tibia	45	46	—	(45)	—	—	44	43	45

The shoulder heights are in cm; values in brackets were obtained on long bones of which the epiphyses were not yet all fused. NF = non fused; F = fused.

Using the total lengths of the long bones and the indices compiled

by von den Driesch and Boessneck (1974), it was possible to estimate the size of the dogs (Table 27.6). From the reconstructed shoulder heights, it appears that the dogs were rather uniform in size, and it is also clear that the young dogs, although they had not yet reached full maturity in terms of epiphyseal fusion, had already reached adult size. All of the animals are of 'medium' size, i.e., with heights at the shoulder of around 45cm or a little taller. This would correspond to the size of the average stray dogs that are still seen today in and around Egyptian villages.

The dogs in the feature C pit appear to have been in good physical condition, at least judging from their skeletons: not a single case of – the usually rather common – healed fractures or fused vertebrae was observed. The only pathology that was noticed was a deformed, slightly asymmetrical, axis in Dog 4.

No evidence was found for the way the animals were dispatched: the hyoid bones of Dog 1, which could be observed while still *in situ*, were unmodified, and none of the cervical vertebrae had any cut marks on the ventral part of the centrum which could be indicative of throat slitting. It should be kept in mind, however, that when throat cutting is carried out to bleed an animal to death, this need not produce any marks on the neck vertebrae or hyoid bones. This is especially the case when it is carried out by experienced persons who keep the animal immobilised properly, either by holding it firmly or by sedating it before the operation. No distorted cervical vertebrae that could be indicative of strangling were observed either.

Six cats in feature E

Directly adjacent to the southern edge of the feature C dog pit, a circular pit of about 50cm in diameter and only 25cm deep, held the bodies of six cats (Fig. 27.7). The animals were found fully articulated and draped along the bottom and around the sides of the pit. Unlike the situation in the dog pit, there was no preferential orientation in the position of the cats. Possibly their arrangement was to a large extent dictated by the small size of the pit.

A detailed description of these small felids can be found in Van Neer *et al.* (2014). Dental eruption (Habermehl 1980), fusion state of the long bones (Habermehl 1985), and size show that the remains are from a male, a young female, and four kittens from two different litters. The male had all its long bones fused and its dentition showed no wear suggesting that this individual was about 1 year of age when it was sacrificed. The female was a subadult that did not have all its epiphyses closed, but was near 1 year of age. The mandibles of the

juvenile individuals still had their deciduous molars and in two of them the 1st molar can be seen almost piercing through the crypt. The mandibles of the two other young cats only have small openings in the ramus, meaning that these individuals were slightly younger and must be from another litter. This is also reflected in the overall size of the mandibles and the postcranial bones. Based on the eruption data of the lower molars, the age at death of these juveniles can be estimated at 4–5 months.

The measurements of the two older individuals show a clear difference in size that can be attributed to sexual dimorphism. Comparison of these measurements with the jungle cat (*Felis chaus*) previously found in Tomb 12 (Linseele *et al.* 2007; 2008) and with a female and male museum specimen of sand cat (*Felis margarita*) show that the felids from feature E can safely be attributed to *Felis silvestris*: they are clearly smaller than jungle cat and larger than sand cat.

Discussion

Status of the animals

In dynastic times, all three of the animal species found in the pit features under discussion were kept as house pets by the ancient Egyptians (Houlihan 1996, 75–108). Of the three, however, it is only the domestic dog that has a confirmed presence in the settlements and cemeteries at other sites of Predynastic age (4000–3100 BC; Flores 2003; 2004; Dreyer *et al.* 2000, 86–89). The dog is also the only one of these species to be depicted in the art of the period, where it is frequently shown involved in the hunting of wild animals, often wearing a collar or held on a leash by its human master (Hendrickx 2006). Prised for their skill in hunting, an elite activity of marginal significance in subsistence by this time, dogs no doubt were also valued for herding, guarding and companionship.



Fig. 27.7. View of the cat burial prior to the lifting of the individuals.

Dog burials are relatively frequent in the HK6 cemetery, but feature C is the only one thus far found undisturbed. It is also the first in which complete and articulated specimens have been recorded allowing for a reconstruction of their shoulder height. These can now be compared with the dogs recovered during the 2009 season of investigation, when excavations revealed one tomb (Tomb 14) and two pit features containing a total of at least ten dogs. Although all were disturbed, long bone preservation was such that six shoulder height reconstructions were possible: 46cm, 51cm, 52cm, 53cm, 54cm and 56 cm. From these it appears that the average size of these individuals seems somewhat larger than those in feature C. They also appear to have been buried with more care, i.e. in burials that were deeper and in two cases were provided with a mat lining. It would be tempting to see the differences in the size of the animals and the effort taken to bury them as evidence for different breeds or classes of dog, i.e., mongrels or the so-called pariah dogs in feature C and valued hunting dogs in the deeper and mat lined burials. Brewer (2001) suggests on the basis of pictorial and skeletal evidence of dynastic times that it may be possible to distinguish between the pariah dog, with a shoulder height of below 50cm, and the larger sight hounds, or the so-called tesem dogs. Further osteometric work should be carried

out on this and other canid material in order to substantiate this idea. As suggested by Brewer (2001, 43) it cannot be excluded that what has been observed thus far represents only a continuum. Boessneck (1988, 84) also warns that with the standard archaeozoological procedures it may be difficult to distinguish sight hounds from pariah dogs.

Outside of Hierakonpolis, there is no archaeozoological evidence for the presence of baboons in the predynastic period. Similarly, artistic representation is also completely absent until Dynasty 0 and early Dynasty 1 (3200–3100 BC), when statuettes of baboons become the most frequent among the small votive figures deposited in local temples throughout Early Dynastic Egypt (Bussmann 2010). The meaning of these figurines is unclear as is their relationship to the baboon god Hedjwer, who appears in the same period as the recipient of royal veneration. Hedjwer is generally believed to represent the royal ancestors, but the subject is still debated (Dreyer 1986, 68–73; Wilkinson 1999, 285; Winter 2006). Due to the stylised nature of many of the small statuettes, species attribution is difficult, but Osborn and Osbornová (1998, 32–33) identify them as hamadryas baboons. The first secure artistic representation of the anubis baboon does not occur until Dynasty 5 (ca. 2400 BC) of the Old Kingdom, when the animal is shown tamed, being led by a leash around its neck or waist through the market place (Houlihan 1996, 105–106). This species can also be identified in the god Baba (Bebon), known from Old Kingdom times, whose aggressive nature made him a potent protector against harmful creatures and inanimate dangers (Leitz 2002, 736–738; Wilkinson 2003, 196).

It is assumed that the baboon in feature B is an anubis baboon because all diagnostic specimens found thus far at HK6, in Tomb 12 and in the backdirt around Tomb 2 (Van Neer *et al.* 2004), belong to that species. Anubis baboons, like the elephants found in Tombs 24 and 33, probably did not live in the area, and most likely were imported from a region further to the south of Hierakonpolis. Even for the first half of the Holocene, when conditions were more humid, there is no evidence for anubis baboon in the Egyptian Nile Valley. Hamadryas baboons, however, probably inhabited the Red Sea mountains during predynastic times, but their presence in the Nile Valley would still represent an importation. From the traumatic lesions seen on the specimens from feature B, Tomb 12 and Tomb 17, it is clear that these animals were held in confinement for a long period of time prior to their sacrifice. In addition, results of dental microwear analysis conducted on the Tomb 12 specimens indicate the baboons were not allowed to feed freely. They were evidently hand

fed on foods such as bread and river reeds, harder than the leaves and fruits they preferred (Merceron 2003).

While the baboon is shown as a tamed pet already in Dynasty 4 (ca. 2500 BC), the cat remains elusive. The identity of faunal remains from a Badarian period (before 4000 BC) grave at Mostagedda (Brunton 1937, 34, 57) is unconfirmed and depictions of what might even conceivably be considered as small felids (as opposed to lions) are extremely rare in predynastic art (see Payne 1993, cat. no. 143, 173; Dreyer 1986, 73, 177; taf, 36.192; taf, 59e). It is not until Dynasty 11 that the artistic record attests to a domesticated status, although some Old Kingdom depictions strongly suggest this was achieved much earlier (Malek 1993; Osborn & Osbornová 1998, 106–110).

It is also worth noting that as was the case for the baboons, a feline goddess named Mafdet makes a sudden appearance in Dynasty 1. Considered a protective power over the royal court, she was called ‘the mistress of the mansion of life’, a part of the palace that has been identified as the royal eating and food storage areas (Gardiner 1938). Although it is still unclear what specific feline is being represented (Osborn & Osbornová 1998, 117), it has been suggested that Mafdet was embodied in the cats which protected these areas from vermin and snakes (Wilkinson 1999, 290). There can be little doubt that the value of cats in this capacity was recognised at an early date.

Although cat bones occur in predynastic settlement deposits at several sites including Hierakonpolis, they attest only to the presence of the species in the vicinity of human habitation (Linseele *et al.* 2007). On the other hand, the cat burials in the elite cemetery at HK6 are the first confirmation of human interest in their presence.

In an attempt to establish whether the cats from feature E should be considered as wild, tamed or even domesticated different lines of possible evidence have been explored (Van Neer *et al.* 2014). Unlike the jungle cat from Tomb 12, the cats from feature E do not show any pathologies that could be indicative of their keeping in confinement. When the differences described in the literature to distinguish between wild and domestic cats, on the basis of the morphology of the mandible (Kratochvíl 1973), are applied to the feature E male and female, it appears that they best match the domestic form. A log-ratio analysis of the postcranial measurements was carried out using the standards calculated by O'Connor (2007) for the house cat. Comparison of these standards often allow wild and domestic cats to be distinguished in north European archaeofaunal assemblages. The values for the male and female from HK6 were calculated and the

same has been done for the Roman cat from Quseir that was identified as domestic on the basis of the morphology of the skull and mandible (von den Driesch & Boessneck 1983). The Quseir cat is very large compared to the house cat standard, and the two Hierakonpolis individuals are smaller than the Quseir cat. The female cat from feature E has mainly negative values against the house cat standard, and the male has both slightly negative and slightly positive values. This means that the osteometric data also suggest that the cats are domestic.

Although both the morphology of the lower jaws and the postcranial measurements point towards the domestic form, some caution is needed. The criteria that were used are those established to distinguish wild and domestic cat in European sites. These may in fact reflect differences at the subspecies level (wild *F.s. silvestris* versus the domestic form derived from *F.s. lybica*). It remains to be verified, through the study of large series of wild *F.s.lybica*, if the criteria hold when applied to Egyptian material.

The six individuals clearly do not represent four kittens with their mother and father. As could be seen from the dental eruption and sizes of the juveniles, they belong to two different litters that were around 4–5 months of age. Wild cats in Egypt have a single litter of young per year (Le Berre 1990, 170). This means that when the juveniles were sacrificed, their mother had to be 16–17 months of age (or 28–29 months, etc.) had she been born in accordance with the same natural reproduction cycle. Since the female in feature E is slightly younger than 1 year of age, it is clear that the natural reproduction pattern has been disturbed. This discrepancy in the ages at death indicates that the cats at or near Hierakonpolis may have had more than one litter a year. Such deviation from the natural reproduction cycle has been observed in African free-ranging female wild cats that are hand-reared; they can have two to three litters per year (Estes 1991, 358–359). This departure from the birth pattern seen in wild cats that have experienced human interaction can be considered as circumstantial evidence for the cultural control of the cats in feature E.

Ritual meaning of the animals

In general, the burial of animals was a rare practice in Predynastic Egypt. Nevertheless, at most cemeteries, there are a few graves in which animals (dog, sheep, goat) have been placed most often with humans, perhaps to serve as pets, companions or food. On the other hand, the mass burial of animals without human accompaniment appears to be a very elite practice that can be documented at other

elite cemeteries of the period (Naqada and Abydos) but never with the frequency observed at Hierakonpolis (Flores 2003; 2004).

As of 2009, more than 70 buried animals have been discovered in the elite cemetery at Hierakonpolis, albeit the graves are often severely disturbed and the skeletons not always complete. These burials appear in four basic forms:

- 1 Animals buried with humans, which tend to be domestic species like dogs or sheep/goats, although baboons have also been found.

- 2 Elaborate tombs for the large and exotic animals, like the elephants and aurochs, which were buried without human accompaniment but equipped with linen shrouds and matting as found in human interments. These tombs were also provided with above-ground wooden architectural markers.

- 3 Tombs containing multiple animals, both domestic and wild, buried in graves that have been dug deeply into the hard ground indicating significant effort, although associated above-ground architecture has not been observed.

- 4 The burial of animals in shallow pits never larger than that necessary for the purpose. This is the category into which the 2008 finds belong.

Recent investigations show that all of these categories are contemporary, thus the variety of taxa and the differential effort expended in their burial indicate the meaning and significance of these animal burials need not be the same. What that meaning might be, however, is difficult to determine.

Symbolically, the wide range of animals may well reflect the chaotic diversity of animal life, their captivity and eventual slaughter a way in which disorder was brought under control. The control of chaos, especially that inherent in nature, was one of the fundamental themes of predynastic iconography and religious beliefs with direct links to the political reality of developing kingship (cf. Kemp 1989). However, the spectrum in the cemetery does not include all of the animal species known and available to them, as demonstrated by the settlement remains. The cemetery record is notably different from the contemporary ceremonial center (HK29A) where gazelle, turtle, and fish play a significant role (Linseele & Van Neer 2003; Linseele *et al.* 2009). While it seems likely that the animals at the ceremonial center were gathered specifically for slaughter and consumption at that venue, it is unclear if this was also the case in the cemetery. In other words, it is unknown whether animals were collected for the expressed purpose of burial in the cemetery, perhaps as part of rituals

of rebirth and/or displays of power over chaos, or whether they were selected for burial owing to the roles they had played in life and the desire for that to continue in the afterlife. As these purposes need not be mutually exclusive, the cemetery selection may have been influenced by all of the above.

In support of the latter suggestion are the results of the 2009 excavations in the HK6 cemetery. Investigations around a large and rich tomb of the Naqada IC–IIA period (Tomb 16), revealed a complex of interconnected fenced enclosures surrounding a variety of tombs and tomb groups containing both human and animal interments (Fig. 27.2). Examination of the owners of the surrounding tombs and their status suggest that tomb location was not arbitrary, but instead was specifically organised perhaps to reflect the layout of the royal/elite residence. In addition to at least nine tombs containing multiple human interments, the complex also includes the burial of an elephant (Tomb 33), aurochs (Tomb 19), hartebeest (Tomb 46), domestic cow and calf (Tomb 36), large male goats (Tomb 35), numerous dogs (Tomb 14, feature D) and a juvenile hippopotamus (feature H).

The elephant and aurochs were placed in elaborate tombs in proximity to the main burial of the ruler (Tomb 16). The ownership and maintenance of such beasts in both life and death would have been an eloquent statement on the power and wealth of their master, and the keeping of a royal menagerie would go on to become a means of legitimising the rule of later pharaohs (Müller-Wollermann 2003). In addition to ostentatious display, control of these animals also allowed their master to take on their powerful natural attributes for himself. The king as a wild bull is well known in late Predynastic art (Hendrickx 2002) and the close relationship the king had with the elephant is reflected on a carved ivory knife handle from Hierakonpolis, among other objects (Whitehouse 2002; Friedman 2004). The sacrifice of fecund and large domestic animals may be seen as an expression of wealth, power over chaos, as well as the desire for a continued food supply in eternity. The hartebeest, hippo and dogs probably allude to the thrill of the hunt, an activity that remained into Dynastic times an elite pastime and mark of physical prowess in addition to its significance in the symbol sphere (Decker & Herb 1994; Hendrickx 2010). Several of the human graves in the Tomb 16 complex included hunting gear as well as subsidiary pit graves containing the dogs of large size.

The excavations have not yet been able to incorporate the pit graves under discussion into a larger context. They remain isolated at the east edge of the cemetery. From their position they may be associated with

the funerary temple precinct, potentially marking its limits in the northeast corner. In this they may mirror Tomb 12 in the southeast, which contained seven baboons, a cat, and a hippo. Marking the corner on the northwest may be Tomb 28, which held an adult dog and sheep; the southwest corner has not yet been investigated. On the other hand, they may be associated with a tomb complex yet to be revealed. Whatever the case, it seems most probable that a protective function can be attributed to the graves by virtue of their position and the animals they contained. The capacity of these animals to guard, protect and defend was certainly recognised by the kings of the first dynasties and this knowledge can no doubt be traced back to the observations and experimentations made by the elite society buried in the HK6 cemetery some 700 years earlier.

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Part 7

Animal exploitation during antiquity

28. Animal exploitation during the Classical/Hellenistic period at Tepe Düzen (SW Turkey): preliminary results

Bea De Cupere, Wim Van Neer, Kim Vyncke & Hannelore Vanhaverbeke

Excavations at Tepe Düzen – located at less than 2km southwest of the classical site of Sagalassos (Burdur province, Turkey) – revealed the existence of a (proto-)urban centre that could be dated to the Classical/Hellenistic period. The study of the faunal assemblage provides insights into animal exploitation during that period. The results were compared with data from Sagalassos (Roman to Mid-Byzantine period) in order to place Tepe Düzen within a broader perspective and to investigate how the relationship between humans and animals changed through time within the same area.

Keywords archaeozoology, Sagalassos, Classical/Hellenistic period, animal exploitation

Introduction

At about 1.8km to the southwest of the classical site of Sagalassos (Burdur province, SW-Anatolia), another settlement called Tepe Düzen (Fig. 28.1) was discovered on a broad flat area. Tepe Düzen extends over two promontories and covers an area of ca. 1.5km east–west and ca. 0.8km north–south, steeply sloping on the west, south and east sides that lead towards the green valley of the Ağlasun River. To the north it is dominated by Zencirli Tepe (1782m) (Fig. 28.2). Nowadays, the area is sparsely vegetated with low grasses and isolated stands of

kermes oak (*Quercus coccifera*), while some wheat is cultivated on the colluvial fan located between Tepe Düzen and Zencirli Tepe. The area is mainly used for sheep and goat herding (Vanhaverbeke *et al.* 2010).

Fragmentary remains of structures at Tepe Düzen have been shown to derive from a (proto-)urban centre, surrounded by impressive defence walls. Excavations started in 2006 and have continued ever since. The excavations of the first 2 years revealed a complex archaeological sequence of at least four architectural building phases with associated floor levels, as well as some related refuse pits. Excavations during the 2008 campaign, on the other hand, yielded parts of what were most likely two different buildings consisting of several rooms, used as a dump area following occupation. A pit that was cut out of the bedrock was found as well. No water springs are available at the site and fresh water had therefore to be provided from cisterns. The remains of an at least 10 m deep cistern are preserved on the site, but most probably several more such structures must have been present at the site when it was occupied.

The pottery was preliminarily assigned to ca. 500–200 BC (Classical/Hellenistic period), with some Hellenistic and very rare Sagalassos red slip ware from the Imperial period. There was indeed only a small amount of chronologically diagnostic sherds, in general very weathered, and coming from an unknown local or regional production centre. Radiocarbon dates have been carried out on five bone samples and suggest a somewhat more recent date, up to the 2nd and possibly even the 1st century BC (Table 28.1).



Fig. 28.1. Geographical location of Tepe Düzen.

This report presents the first results of the faunal analyses that have been carried out during the three first excavation campaigns (2006–2008) at Tepe Düzen. The study aims at providing a first impression of animal exploitation at this urban centre during the Classical/Hellenistic period. By comparing the data to those from Sagalassos, it should also be possible to draw some inferences concerning human–animal relationships through time within the same area.

Table 28.1. Radiocarbon ages of Tepe Düzen. Calibration was carried out using CALIB 5.0 (Stuiver & Reimer 1993).

<i>Laboratory nr</i>	<i>Context nr</i>	<i>Uncalibrated dates BP</i>	<i>Calibrated date (2 σ) BC</i>
Beta-244812	2006 TD 46-31	2150 $\pm$ 40	360–280 & 260–60
Beta-244813	2006 TD 143-80	2350 $\pm$ 40	510–380
Beta-244814	2007 TD 12-9	2220 $\pm$ 40	390–180
Beta-244815	2007 TD 22-32	2210 $\pm$ 40	390–170
Beta-244816	2007 TD 66-59	2150 $\pm$ 40	360–280 & 260–60

The faunal material

The majority of the animal remains was obtained through hand-collection in the excavation trench. The material is very fragmented, resulting in a high number of unidentifiable bones. Soil samples were taken from interesting or promising contexts and wet-sieved using a series of 4mm, 2mm and 1mm meshes; a total volume of 538 litres was screened. However, the residues from these sieved samples yielded few identifiable remains. Until now no chronological phases could be distinguished and therefore, the faunal material has been treated as one large assemblage in this report. Some bone objects were found, mostly including worked astragali from sheep and goat, but these have not been included in this study.

The taxonomic composition of the animal remains from Tepe Düzen is provided in [Table 28.2](#); hand-collected and sieved materials were kept separate from each other. Nonmammalian remains are low in number. Mollusc shells were found in small quantities and included terrestrial gastropods only; no shells from fresh water or marine molluscs have yet been found. The mollusc shells could be attributed to a large gastropod of the genus *Helix*, most probably *Helix cincta*, and to two small species, i.e. *Ceciloides tumulorum* and *Jaminia loewii*.

These shells are considered to be the remains of intrusive species that lived on the site during or after the human occupation. Fish bones are very rare ($n=10$) and, due to the fragmentary nature of the material, only four pieces could be identified to taxon. These include two scales as well as an entopterygoid of Cyprinidae (carp family), that may come from the local Ağlasun River. Another scale derives from a tuna (*Thunnus* sp.) reflecting trade-links with the coast during the Classical/Hellenistic period. Reptiles are represented by the tortoise (*Testudo graeca*) although only carapace fragments have been found from this species. No anthropogenic traces were observed on this material and it is assumed that they are also the remains of intrusive animals. Wild birds are represented by the femur of a duck (Anatinae), by two posterior phalanges of stork (*Ciconia* sp.), by a scapula, a humerus, an ulna and two femora of chukar (*Alectoris chukar*), by the humerus of coot (*Fulica atra*) and by several skeletal elements from passerine birds of both medium (cf. *Turdus merula*) and large size (cf. *Pica pica* and *Garrulus glandarius*). Remains of domestic chicken represent a little more than half the total number of identified bird bones.

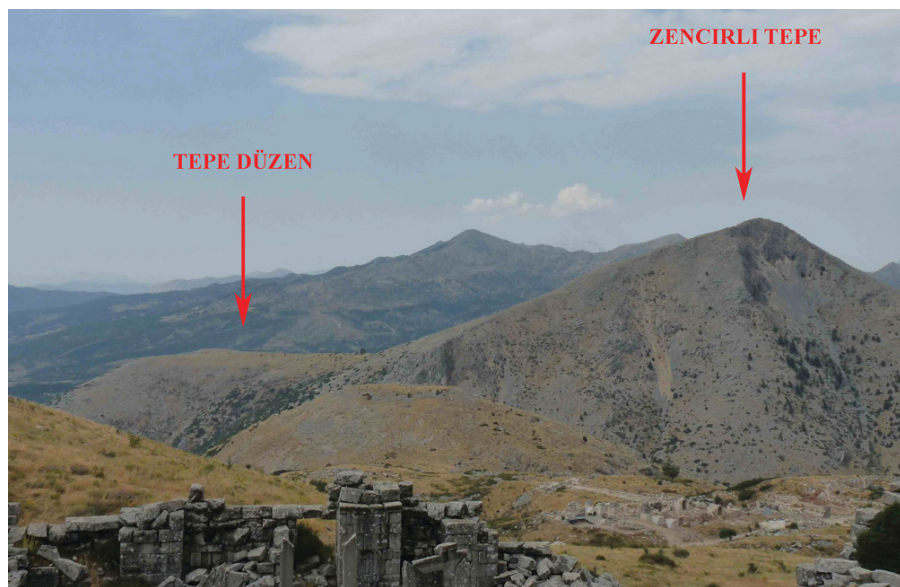


Fig. 28.2. View from Sagalassos onto the wide flat area of Tepe Düzen, and Zencirli Tepe.

Small mammals are very poorly represented. There are remains of some small rodents, i.e. grey hamster (*Cricetulus migratorius*), house mouse (*Mus musculus*) and lesser mole rat (*Spalax leucodon*). Several bones could be assigned to the European hare (*Lepus europaeus*). Two

skulls and a tibia have been identified as weasel (*Mustela nivalis*), while three other elements – a humerus, an ulna and a metapodial – belong to another, larger mustelid, i.e. the badger (*Meles meles*). Cut marks have been found on the humerus indicating that this individual was hunted, not only for its fur, but also perhaps for consumption. The brown bear (*Ursus arctos*) is represented by a single find, a distal radius that also displays cut marks, just above the distal articulation. Remains of cervids are more common and consist mainly of red deer (*Cervus elaphus*); some bones could be attributed to fallow deer (*Dama dama*), while roe deer (*Capreolus capreolus*) seems to be completely absent. One antler fragment has been positively identified as fallow deer, but the other antler fragments are more likely to be from red deer. The presence of cervids suggests that the landscape around the site was open with some woodland and shrubs.

The remains of domestic dog (*Canis lupus* f. *familiaris*) that were found in several instances, show a variation in size indicating that dogs of different sizes lived at Tepe Düzen. Both medium and large-sized individuals were retrieved from the excavation material. One fragment of a large ulna might rather be from a wolf (*Canis lupus*), but this could not be established with certainty. Equid remains were frequently identified and consist almost exclusively of donkey (*Equus africanus* f. *asinus*); two first phalanges have been identified with certainty as horse (*Equus ferus* f. *caballus*). The donkey remains all come from individuals of very small stature. A complete metacarpal permitted calculation of the withers height (von den Driesch & Boessneck 1974) yielding a value of approximately 1m. But, other, less completely preserved specimens show that even smaller individuals must have been present at Tepe Düzen. No traces of butchery or consumption have been found on the equid bones.

Table 28.2. Taxonomic composition of the faunal remains (expressed as NISP; + = present).

	Hand-collected	Sieved total vol. 538 l
Molluscs		
<i>Helix</i> cf. <i>cincta</i>	9	–
<i>Ceciloides tumulorum</i>	–	4
<i>Jaminia loewii</i>	1	–
Fish		
Cyprinidae sp.	–	3
<i>Thunnus</i> sp.	–	1
Reptiles		
<i>Testudo graeca</i>	11	–
Wild birds		
<i>Ciconia</i> sp.	2	–
Anatinae sp.	4	–
<i>Alectoris chukar</i>	2	–

<i>Fulica atra</i>	3	–
Passeriformes sp.	9	–
Wild mammals		
<i>Lepus europaeus</i>	19	–
<i>Spalax leucodon</i>	3	–
<i>Mus musculus</i>	–	2
<i>Cricetulus migratorius</i>	–	1
Rodentia sp.	–	77
<i>Ursus arctos</i>	1	–
<i>Mustela nivalis</i>	3	–
<i>Meles meles</i>	3	–
<i>Canis lupus</i>	1	–
<i>Cervus elaphus</i>	52	–
<i>Dama dama</i>	6	–
<i>Cervus/Dama</i>	2	–
<i>Sus scrofa</i>	+	–
<i>Capra aegagrus</i>	+	–
Domestic		
<i>Gallus gallus</i> f. domestica	22	–
<i>Canis lupus</i> f. familiaris	21	–
<i>Equus ferus</i> f. caballus	2	–
<i>Equus africanus</i> f. asinus	74	–
Equidae	9	–
<i>Sus scrofa</i> f. domestica	799	4
<i>Capra aegagrus</i> f. hircus	229	–
<i>Ovis ammon</i> f. aries	224	–
<i>Capra/Ovis</i>	5685	38
<i>Bos primigenius</i> f. taurus	2681	–
Total identified	9877	130
Unidentified mammal remains	19,051	5106
Unidentified bird remains	45	3
Unidentified fish remains	–	6

Most of the identified remains (99%), however, are from domestic species that were traditionally used as food animals, namely sheep (*Ovis ammon* f. aries), goat (*Capra aegagrus* f. hircus), cattle (*Bos primigenius* f. taurus) and pig (*Sus scrofa* f. domestica). Looking at the proportions (expressed in percentages of NISPs) of these food animals, it appears that sheep and goat are the best represented (64%) and that both species are present in about equal numbers. Cattle remains represent 28%, and only 8% can be assigned to pig. Judging from the large size of some goat and pig bones, it seems likely that wild goat (*Capra aegagrus*) and wild boar (*Sus scrofa*) are present within the bone assemblage.

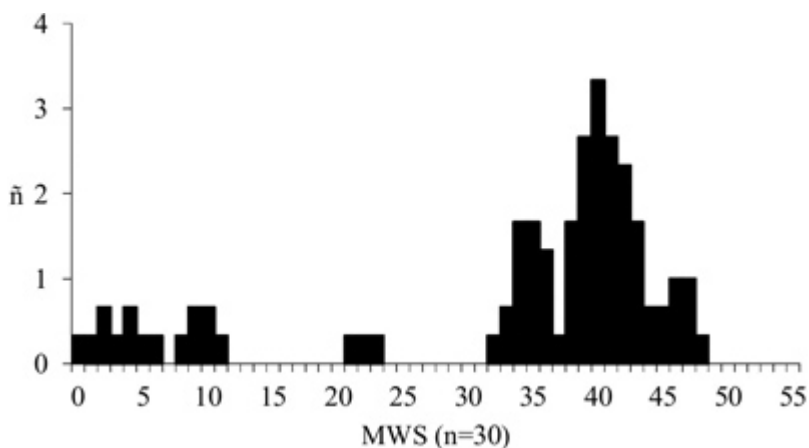


Fig. 28.3. Mandibular wear stages (MWS) of sheep/goat, according to Grant (1982); $\bar{n}$: running mean.

Sheep/goat

Age at slaughter of these domestic mammals has been established using the Grant's (1982) methodology. It is striking that a large proportion of the sheep/goats from Tepe Düzen are from older individuals (Fig. 28.3). The majority has a mandibular wear stage higher than 32, with a large peak around 40. The latter group comprises animals with a third molar displaying medium wear, or an age of over 4 years (Boessneck & von den Driesch 1975, 65). This indicates that they were not only kept for their meat, but that they also must have provided products such as milk. In the case of sheep, wool may have been important in textile manufacturing, something also suggested by several loom weights that were found on the site. Three complete metapodials and two radii permitted wither height calculations (von den Driesch & Boessneck 1974) of 57cm to be made for two goat individuals and 51cm, 59cm and 60cm for sheep. This corresponds to rather small animals. In one context, the almost complete skeleton of a foetus has been recovered; several other contexts yielded isolated bones of foetal animals.

Cattle

The number of mandibles of cattle was too low to establish slaughtering profiles. It was, however, clear that the remains of young individuals also occur in addition to the remains of older animals. A pelvic bone of cattle shows traces of the beginning of coxarthrosis, a pathological deformation that may be related to traction or other heavy-duty work (cf. Hüster 1990, 44–45, fig. 18). Other draught-related anomalies, as described by Bartosiewicz *et al.* (1997) on the

phalanges and observed at Sagalassos (De Cupere *et al.* 2000), are present only to a slight degree. Therefore, it is believed that cattle were kept for both their meat and dairy products, and – to a lesser extent – for draught power. The cattle remains appear to originate from rather small animals; calculation of wither height was only possible on one metacarpal from an animal of approximately 117cm high.

Table 28.3. Slaughter age of pigs, based on eruption and wear of the mandibular teeth; age classes according to Boessneck & von den Driesch (1975).

	Age	Tepe Düzen
M1 absent, Pd4 present	< 6 months	4
M2 erupted; M3 absent	1–1.5 years	2
M3 slightly worn	> 2 years	5

Pig

Mandibles of pig were also too few to establish slaughtering profiles, but data on the eruption and wear of the mandibular teeth have been summarised in [Table 28.3](#). From these data it is clear that some of the pigs were slaughtered very young, before the eruption of the M1. Another part of the pig population reached an age of somewhat more than 2 years, so that their M3s appeared slightly worn (Boessneck & von den Driesch 1975, 100, table 23). There are, however, no indications of old animals within this assemblage.

Discussion

The relative abundances of the main domestic mammals at Tepe Düzen were compared to those observed at Sagalassos for different periods at the classical site ([Fig. 28.4](#)). For this comparison, data from Sagalassos were obtained from the large assemblages, related to large buildings and alterations of monumental buildings (De Cupere 2001, 137–141, fig. 99), and from the few contexts that have been dated to the Mid-Byzantine period. Some similarities do exist between forms of animal exploitation at Tepe Düzen and the Imperial period at Sagalassos. A heavy reliance on sheep and goat has indeed been observed for the first centuries AD at Sagalassos, although the proportion of the small livestock is even larger at Tepe Düzen. This may reflect a subsistence economy, favouring the herding of small livestock. This kind of herding economy is in sharp contrast with the increasing reliance on beef consumption – at the expense of sheep/goat – during the Late Roman period at Sagalassos. The economy at Sagalassos in this period was flourishing and as a consequence,

agricultural activities intensified (see also Vanhaverbeke *et al.* 2007). The need for draught animals may have increased, as suggested by the much older age at which cattle were slaughtered in Late Roman times (De Cupere 2001, 92–94) and the high incidence of pathological deformations on the phalanges that can be related to hard labour (De Cupere *et al.* 2000). The beginning of the Early Byzantine time was again characterised by a series of wars and natural disasters, which resulted in the destruction of Sagalassos' economy (Waelkens 1997). The inhabitants of the town and the territory may have turned again towards a more subsistence-based economy with an emphasis on the herding and breeding of sheep and goat (De Cupere 2001, 141). This situation continued into the Mid-Byzantine period.

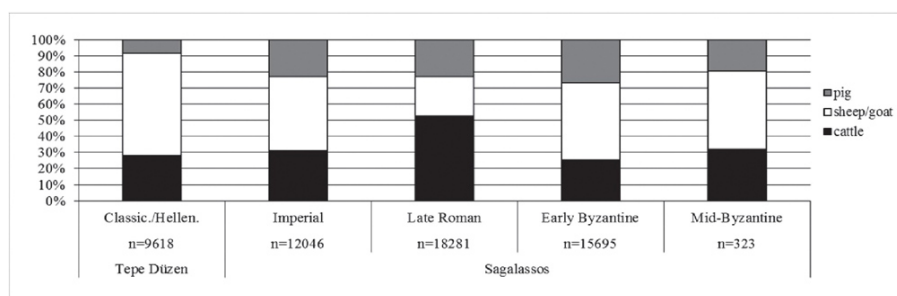


Fig. 28.4. Relative abundance of sheep/goat, cattle and pig at Tepe Düzen and Sagalassos (Classical/Hellenistic: 4th–1st century BC; Imperial: 1st–3rd centuries AD ; Late Roman: 4th–1st half 5th century; Early Byzantine: 2nd half 5th–7th centuries; Mid-Byzantine: 9th/10th–12/13th centuries).

Sheep and goat remains occur in, more or less, equal proportions at Tepe Düzen, in contrast to the situation at Sagalassos where goats are on average more numerous. Although goats thrive better than sheep in the rough environment of the region, the inhabitants of Tepe Düzen may have favoured sheep in view of the importance they attached to wool production. This is also suggested by the loom weights and spindle-whorls found at the site, although it is not excluded that fibres other than wool were also processed. Slightly higher numbers of sheep are observed for the Imperial period at Sagalassos and there is an inscription that indicates the presence of a guild of wool-dyers within the city during the 2nd century AD (De Cupere 2001, 141). Therefore, it is believed that this wool production must have retained its importance from the Classical/Hellenistic period through the Imperial period. In later periods, wool production probably diminished at Sagalassos as indicated by the increasing number of goats.

The site of Tepe Düzen – at an altitude of about 1400m a.s.l. – could

be reached from the surrounding valleys by two rock-cut pathways that were not wide enough and too rough to be used by carts or wagons (Vanhaverbeke *et al.* 2010). Pack animals must have been ideal in such a situation. The rather large number of donkey remains that were found at Tepe Düzen therefore must be related to the topographical setting of the site and its accessibility. The absence of pronounced pathologies on the extremities of cattle, such as the distal metapodials and phalanges, suggests that these animals were of much less importance for transport or other heavy-duty work. This contrasts with Sagalassos, where the high incidences of draught-related pathologies found in cattle (De Cupere *et al.* 2000) were related to an intensification in agricultural production, especially during the Late Roman period (Vanhaverbeke *et al.* 2007).

As at Tepe Düzen, the overall share of wild mammals is very small within the mammalian assemblage of Sagalassos. However, when the cervids are considered, and red deer in particular, it is clear that their remains are relatively more common at Tepe Düzen compared to classical Sagalassos (Imperial, Late Roman and Early Byzantine periods). In the Mid-Byzantine contexts at Sagalassos, however, cervids occurred relatively frequently in the faunal assemblage. This higher number of deer bones in both the Classical/ Hellenistic period of Tepe Düzen and the Mid-Byzantine period of Sagalassos might be explained in terms of changing environmental conditions. Considering the preferences of red deer and fallow deer for landscapes with interspersed forests, a possible explanation could be that the environment of the site was more wooded during these two periods than it had been in Roman-Early Byzantine times. The charcoal assemblages from Tepe Düzen are indeed indicative for better woodland resources in the Classical/Hellenistic period (E. Marinova pers. comm. 2009) and similar observations have been made from the pollen analyses (Vermoere *et al.* 2000). An alternative, or additional, explanation for the greater abundance of deer could be that by that time the area had become less densely inhabited by people. As a consequence, human pressure on the local environment may have been reduced, resulting in a considerably larger deer population.

Taphonomic reasons, such as bad preservation and recovery technique, could in principle be responsible for the very low number of fish remains. However, the identified pieces include fragile elements such as scales and the extensive sieving did not produce any significant amount of material. Among the fresh water fish only cyprinids have been identified and the presence of tuna bone is an indication for trade. It is, therefore, believed that fishing was not a

common practice during the Classical/Hellenistic period in the area. Fish remains are much more common at Sagalassos and many different species are represented there, including Anatolian fresh water and marine fishes, as well as exotic fresh water fish (Van Neer *et al.* 1997; 2000). However, this taxonomic richness does not indicate intensification of local fisheries as all the fish, including the Anatolian freshwater fish, were imported (Van Neer *et al.* 2008).

Conclusion

The 2006–2008 excavations at Tepe Düzen yielded a faunal assemblage consisting of about 10,000 identifiable specimens. The data reveal that the economy was based mainly on the herding and breeding of sheep and goat, and to a lesser extent cattle and pig. Bones of sheep and goats are present in about equal proportions and both species provided products, such as milk and wool. Cattle, on the other hand, must rather have been raised for its meat and milk. There is no indication that cattle were regularly used for heavy duty work. The transport of goods was mainly carried out with donkeys. Comparison of faunal data from Tepe Düzen with the faunal material from Sagalassos, a Roman-Byzantine site less than 2km away, showed that sheep and goat herding, and the associated production of milk and wool, continued to be important during the Imperial period, although by this time these products seem to have been less emphasised.

Wild taxa make up a very small part of the assemblage at Tepe Düzen. Nevertheless, remains of cervids are not uncommon and are more frequently observed than at Sagalassos, suggesting environmental changes or greater human hunting pressure during the transition from the Classical/Hellenistic period to the Imperial period. The opposite trend is observed for the transition from the Early to Mid-Byzantine period where an increase in the numbers of cervid bones was observed in the faunal assemblage suggesting the presence of a larger deer population.

The overall picture of animal exploitation at the site of Tepe Düzen, as reflected in the faunal analysis, is that of a subsistence economy, mainly based on sheep and goat herding. The animals raised were rather small and the use of cattle in agriculture was probably quite limited. Such an animal husbandry strategy would correspond best to a rural community. However, in contrast, extensive town ruins have been brought to light at this site. In addition, the presence of tuna at the site provides evidence for sporadic (commercial) relationships with the coastal area during the Classical/Hellenistic period. Further

excavations at Tepe Düzen will without any doubt provide much more information which will allow the verification of these preliminary results.

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29. Une accumulation d'équidés à *Berytus*: approche taxinomique et taphonomique

Yasha Hourani & Tarek Oueslati

L'étude porte sur un dépotoir riche en ossements animaux daté de la première moitié du I^{er} s. ap. J.-C. Cette accumulation est localisée à la frange Est de la ville romaine de Beyrouth. Les équidés dominent l'assemblage avec au moins 23 individus. Du point de vue taxinomique l'ensemble est très sélectif dans la mesure où tous les restes dentaires issus d'individus adultes ont été attribués à l'âne. Cela suggère sa forte implication dans l'économie de la ville. Du point de vue taphonomique, il s'avère que la viande de ces équidés a été au moins partiellement prélevée. De même certaines interventions sur leurs carcasses sont à l'origine du déficit du membre antérieur et des bas de pattes. En ce qui concerne les autres composantes de l'assemblage, des déchets de boucherie de production de masse de bœuf sont attestés. La technique de découpe est caractéristique de l'époque romaine et se retrouve dans les différentes provinces romaines de l'Empire. Ainsi, nous sommes en présence d'un dépotoir situé extra muros, lieu d'élimination des déchets.

Keywords Beyrouth, époque romaine, dépotoir, *extra muros*, âne, cheval, boucherie, équarrissage, gestion des déchets

An equine accumulation in Roman *Berytus*: a taxonomic and taphonomic approach

This study concerns a dump rich with faunal remains and dated to the first half of the 1st century AD. The accumulation is located at the eastern fringe of the Roman city of Beirut. The equids dominate the assemblage with 23 individuals. From a taxonomic point of view, the set is very selective as all the dental remains belonging to adult individuals were

attributed to the donkey. This statement suggests that this animal was strongly involved in the economic activities of the city. The taphonomic approach reveals that the equine meat was partially defleshed. In addition, some interventions on the carcasses are the reason of the deficit in the representation of the fore and the lower limbs. Concerning the other components of the assemblage, bovine butchery waste is present. The butchery technique reveals a mass production activity, characteristic of the Roman period and found in the different provinces of the Empire. Thus we are in the presence of a dump located extra muros in an area used for waste disposal.

Keywords Beirut, Roman period, faunal remains, *extra muros*, donkey, horse, butchery, quartering, waste management

Introduction

Le site JEM002 se situe dans le quartier Jemmayzeh à Beyrouth. La fouille¹ a mis au jour une accumulation d'ossements animaux issue d'un niveau daté de la première moitié du I^{er} s. ap. J.-C. (Fig. 29.1). A l'échelle de la ville romaine, cette découverte se situe à la frange Est (Fig. 29.2), dans un secteur utilisé comme zone de décharge.



Fig. 29.1. Vue d'ensemble du dépotoir de JEM002, US 3346. L'échelle figurée est de 50cm.

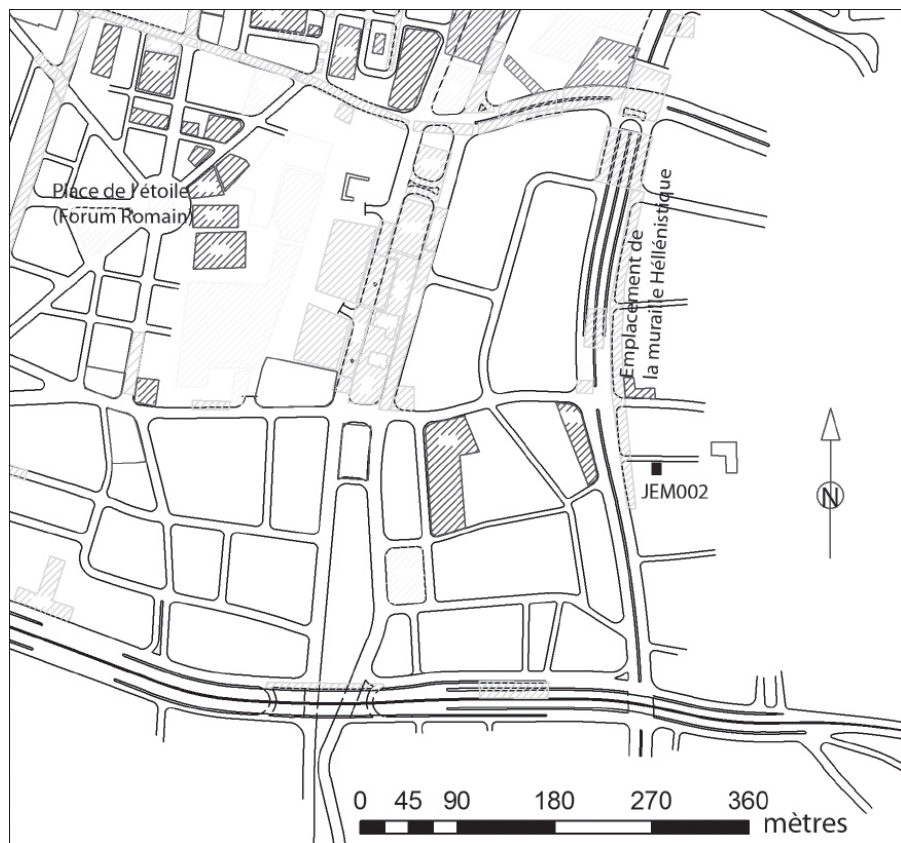


Fig. 29.2. Plan de Beyrouth (modifié d'après Curvers et Stuart 1998-1999). Localisation de la Place de l'étoile qui correspond à l'emplacement du forum romain, de la muraille hellénistique et du site JEM002. La muraille hellénistique correspond à la limite de la ville romaine jusqu'à la première moitié du 1er siècle après J.-C. A partir de la deuxième moitié de ce siècle, la ville s'étendra vers le Sud.

Table 29.1. Quantification des restes déterminés en Nombre de Restes (NR), Poids de Restes (PdR) et Nombre Minimal d'Individus (NMI).

	<i>Taxa</i>	<i>NR</i>	<i>PdR</i>	<i>NMI</i>
Équidés	<i>Equus africanus</i> f. <i>asinus</i>	42		21
	<i>Equus ferus</i> f. <i>caballus</i>	1		1
	<i>Equus</i> sp.	990		1
	Total équidés	1033	22,545	23
Bovinés	<i>Bos primigenius</i> f. <i>taurus</i>	191	9875	6
Caprinés	<i>Ovis orientalis</i> f. <i>aries</i>	4		2
	<i>Capra aegagrus</i> f. <i>hircus</i>	16		4
	<i>Ovis/Capra</i>	56		
	Total caprinés	76	817	6
Suinés	<i>Sus scrofa</i> f. <i>domesticus</i>	163	2134	7
Camélidés	<i>Camelus</i> sp.	9	1380	1
Canidés	<i>Canis</i> sp.	1	8	1
Hyénidés	<i>Hyaena hyaena</i>	5	97	1
	Total mammifères	1478	36,856	45
Oiseaux	<i>Gallus gallus</i> f. <i>domesticus</i>	7	6	1
Poissons	Carangidae	2	0.42	1
	Gadidae	1	0.44	1
	Moronidae	1	0.02	1
	Serranidae	5	0.71	1
	Sparidae	1	0.57	1
	Raie	1	0.13	1
	Requin	1	2.20	1
	Total poissons	12	4.49	12
	Total	1497	36,866.49	53

L'assemblage osseux comporte 2853 restes.² A partir d'une analyse taxinomique et taphonomique, nous aborderons les activités qui sont à l'origine de cette accumulation importante de déchets. S'il est vraisemblable que nous sommes en présence d'un processus d'élimination de déchets générés par la ville, la prise en compte d'activités extra-urbaines reste néanmoins incontournable. Dans cette perspective, nous mettrons en évidence d'éventuelles remobilisations d'une partie de ces déchets dans le cadre de différentes chaînes

opératoires du sous-système technique d'exploitation des ressources animales (Vigne 1998).

La détermination ostéologique révèle l'abondance des équidés. Le spectre est complété par le bœuf, les caprinés, le porc, les camélidés, les canidés, la hyène rayée, ainsi que des poissons de mer et le coq (Table 29.1).

La dominance des équidés a nécessité l'application des méthodes morphologiques et métriques pour la discrimination entre les différentes espèces du genre *Equus*. Pour notre cadre chronospacial, les données paléobiogéographiques renseignent sur cinq taxons potentiels: le cheval et l'âne domestiques, l'hémione hémippe, la mule et le bardot (Ducos 1968 ; Burleigh 1986 ; Groves 1986 ; Uerpmann 1987).

Ainsi, dans un premier temps nous exposerons les méthodes et les résultats de la détermination des équidés. Nous décrirons ensuite la répartition de l'âge et du sexe des individus, leur stature et les pathologies osseuses.

Caractérisation des équidés

Détermination taxinomique

Les méthodes de discrimination entre les différentes espèces du genre *Equus* sont fondées sur des critères morphologiques et morphométriques de plusieurs éléments crâniens et post-crâniens. L'application de ces méthodes à notre échantillon a permis d'éliminer la probabilité de l'occurrence de l'équidé sauvage potentiel, *Equus hemionus* (Uerpmann 1986; 1991; Boessneck 1987; Vila 1998; Eisenmann 1980; 1981). Les résultats métriques que nous présentons dans cette étude excluent donc la comparaison avec l'hémione hémippe. Le référentiel métrique de comparaison est issu des données mises en ligne par V. Eisenmann (<http://vera-eisenmann.com>). Les mesures relevées sur le crâne suivent le système de mesures établi par Eisenmann (1980) et sur les dents jugales et les os des membres celui établi par Eisenmann et Mashkour (2000).

La représentation graphique des données craniométriques à l'aide d'un diagramme de rapports (Simpson 1941) permet la discrimination entre les espèces (Eisenmann 1980; 1986). Notre assemblage contient huit crânes. Toutefois les conditions de conservation et les fortes déformations limitent le nombre de spécimens étudiables et les seules mesures discriminantes ont été obtenues sur le crâne 31. La conformation du museau (la longueur, la largeur entre les incisives et la largeur minimale, respectivement les mesures 5, 17 et 17 bis; Fig. 29.3) de ce spécimen se rapproche de celle du cheval. Toutefois, ce crâne est issu d'un individu sub-adulte, ce qui impose une certaine

prudence dans l'interprétation des résultats.

La morphologie des dents jugales, précisément le dessin de l'émail à la surface occlusale, permet également de caractériser les différentes espèces (Churcher et Richardson 1978; Armitage et Chapman 1979; Eisenmann 1980; 1981; 1988; Uerpmann et Uerpmann 1994). Les dents jugales sont les éléments les mieux conservés dans notre assemblage. La discrimination entre les espèces et les formes hybrides du genre *Equus* se base notamment sur ces éléments dans notre étude.

La plupart des dents jugales supérieures présente une morphologie asinienne (NMI = 15; Fig. 29.4).³ Le protocône est court et symétrique, le sillon postprotocônal est court, le parastyle et le mésostyle sont simples, le pli caballin est absent et le nombre de pli des fossettes est réduit. Cinq spécimens (dont le crâne 31) présentent de nombreux plis au niveau des fossettes et un pli caballin. Les fossettes complexes, le pli caballin et le protocône symétrique sont des caractères qui se retrouvent chez la mule (Uerpmann 2002 in Johnstone 2004, tab. 4.1, 165 et fig. 4.3, 166). Nous avons donc comparé nos données métriques à des spécimens de référence de l'âne, du cheval et de la mule en rapportant la longueur du protocône à la surface occlusale⁴ de la dent (Fig. 29.5, a–b; Mashkour 2001). Notre échantillon se trouve dans l'aire de répartition de l'âne. Seul le crâne 31 se distingue du lot. Par rapport aux autres spécimens, la P3 a une surface occlusale plus développée et le protocône est de longueur relativement moyenne; les molaires ont une surface occlusale plus grande et le protocône plus long. La P3 et la M1 se trouvent dans la zone de recouvrement entre le cheval et la mule. La M2 est incluse dans la variabilité du cheval. Comme nous l'avons déjà mentionné, ces dents appartenant à un individu sub-adulte sont peu usées et nous resterons prudents sur leur attribution spécifique.

---•--- JEM 002 crâne 31

--- Âne

— Mule

— Cheval

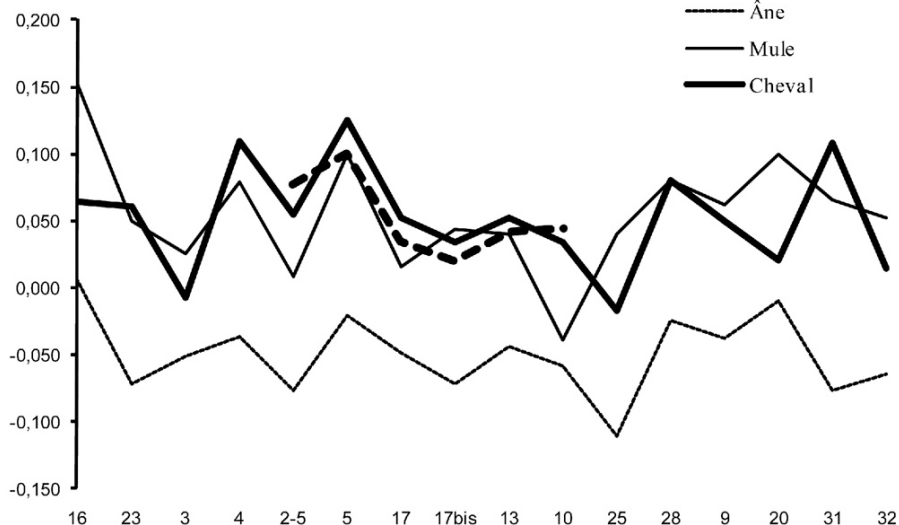


Fig. 29.3. Diagramme de différence en logarithme des mesures crâniennes du cheval (C117), de la mule (UM3), de l'âne et du crâne 31 de JEM002. L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

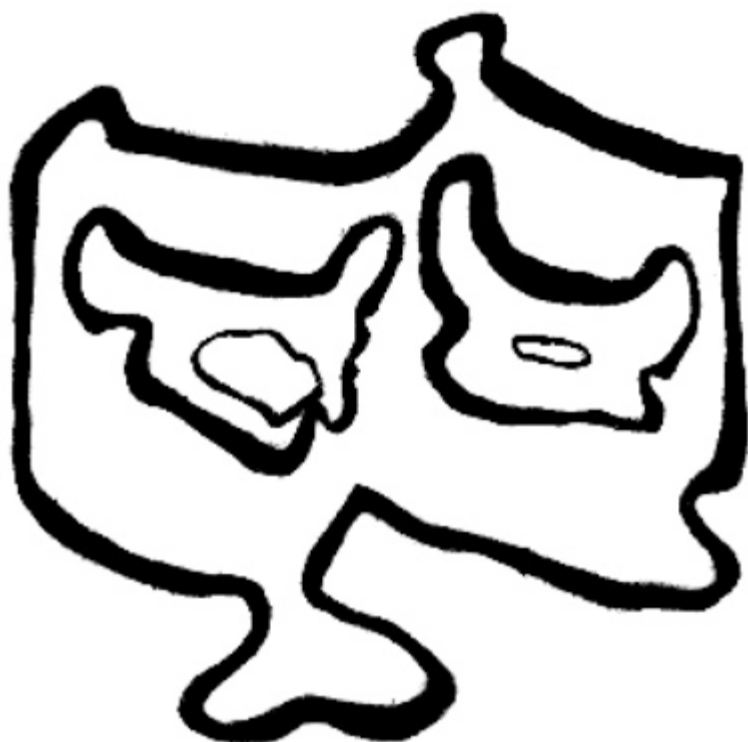


Fig. 29.4. Dessin en vue occlusale de la P3 gauche du maxillaire 39

(Longueur occlusale = 24.7mm; largeur occlusale = 23.7mm; Longueur du protocône = 9.17mm).

Les dents jugales inférieures (NMI=23) présentent deux variabilités morphologiques. La première se caractérise par une double boucle de type sténonien; le sillon lingual est en 'V', le métaconide et le métastylide sont arrondis avec des bords linguaux convexes (Fig. 29.6, a). La deuxième variabilité se caractérise par un sillon lingual en 'V' peu profond à branche déjetée (*tick shaped*) et une double boucle asymétrique: le métastylide est arrondi et le métaconide est allongé (Fig. 29.6, b). Dans ces deux variabilités, le sillon vestibulaire est court ; il ne pénètre pas le col du métastylide et du métaconide. Ces deux morphologies caractérisent les asiniens (Armitage et Chapman 1979). Les dents jugales inférieures sont de ce fait issues d'ânes domestiques.

Nous notons que des dents de morphologie différente se retrouvent dans la même série dentaire. Par ailleurs, le pli caballinide est plus développé sur les dents appartenant à la deuxième variabilité morphologique.

La discrimination de l'espèce à partir des incisives est plus problématique. Dans notre échantillon, plusieurs troisièmes incisives inférieures ne présentent pas de cornet. Généralement, l'absence du cornet est plus fréquente chez les asiniens que chez les caballins et les hémioniens⁵.

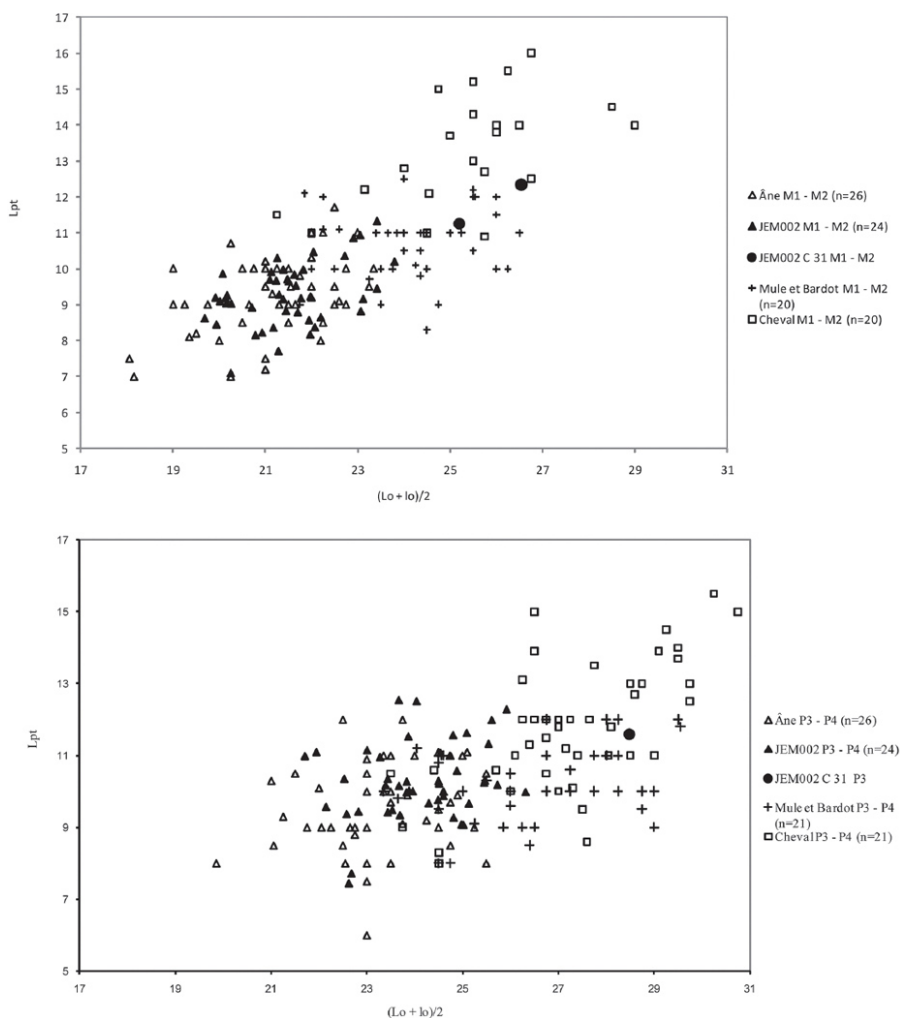


Fig. 29.5. Diagramme de dispersion des mesures des dents jugales supérieures des équidés de JEM002 comparées à celles de l'âne, du cheval, de la mule et du bardot. Le crâne 31 de JEM002 (C 31) est représenté individuellement (données métriques: <http://vera-eisenmann.com>): a: les molaires (M1 – M2); b: les prémolaires (P3–P4).

Les os des membres sont moins représentés que la tête osseuse dans notre assemblage (voir Fig. 29.21). Parmi ceux-ci, le métacarpe et la phalange I sont bien appropriés à la discrimination entre les espèces. Ces éléments peuvent être comparés avec les différentes espèces potentielles à l'aide d'un diagramme de rapports (Eisenmann et Beckouche 1986; Dive et Eisenmann 1991). Notre échantillon contient trois métacarpes ayant donné des mesures. La Figure 29.7 illustre les proportions d'un métacarpe robuste (voir le rapport entre la largeur et la longueur de l'os, respectivement les mesures 3 et 1). Sa largeur

articulaire distale est plus développée que sa largeur supra-articulaire (mesures 11 et 10). La profondeur interne du condyle médial est moins développée que sa profondeur externe (mesures 13 et 14). Ce métacarpe est ainsi de morphologie caballine. La [Figure 29.8](#) montre un métacarpe plus gracile. La diaphyse de cet os est plus large que profonde; et la largeur articulaire distale est plus importante que la largeur supra-articulaire. Ce métacarpe pourrait appartenir à un cheval de petite taille ou à une mule. La [Figure 29.9](#) présente une comparaison entre les trois métarpes de JEM002 et l'âne. Le métacarpe 5 qui a livré uniquement deux mesures est le plus petit spécimen, il se rapproche de la taille de l'âne.



Fig. 29.6. Dessins en vue occlusale des deux morphologies observées sur les dents jugales inférieures des équidés de JEM002. Les mesures de la surface occlusale sont en (mm): A: M2 droite de la mandibule 54 (Longueur occlusale = 24.1; largeur occlusale = 12.6; Longueur du postflexide = 8.7; Longueur de la double boucle = 12.6); B: P4 gauche de la mandibule 53 (Longueur occlusale = 23.7; largeur occlusale = 14.3; Longueur du postflexide = 10.7; Longueur de la double boucle = 14.7).

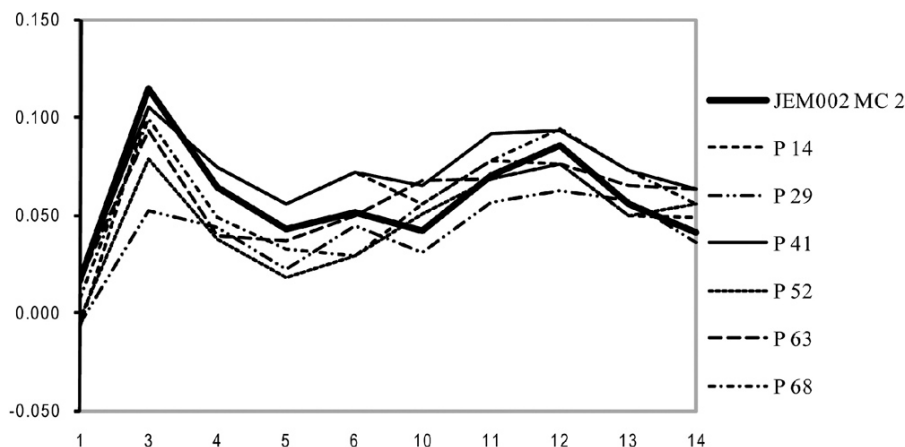


Fig. 29.7. Diagramme de différence en logarithme des mesures du

métacarpe 2 de JEM002 et du cheval de Przewalskii. L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

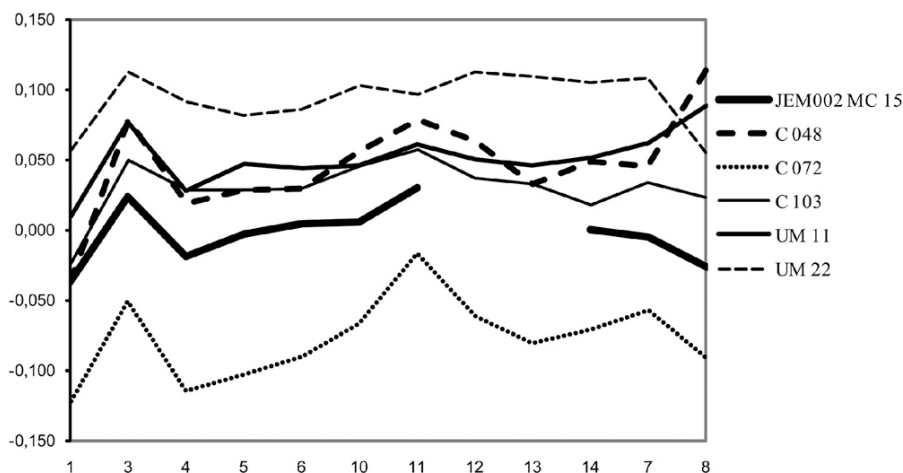


Fig. 29.8. Diagramme de différence en logarithme des mesures du métacarpe 15 de JEM002, du cheval (C048, C072, C103) et de la mule (UM11, UM22). L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

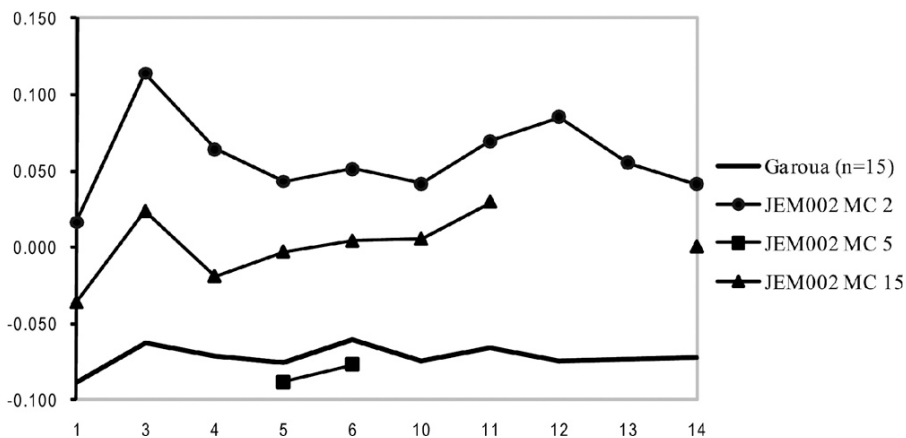


Fig. 29.9. Diagramme de différence en logarithme des mesures des métacarpes de JEM002 et de l'âne domestique de Garoua – Cameroun. L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

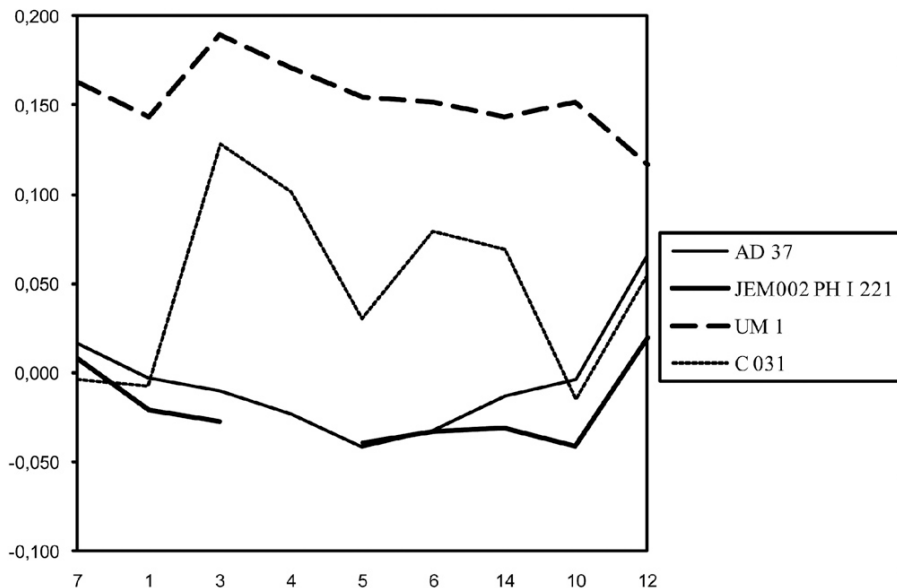


Fig. 29.10. Diagramme de différence en logarithme des mesures de la phalange I (221) de JEM002 et de la phalange I antérieure de l'âne (AD37), de la mule (UM1) et du cheval (C031). L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

Deux phalanges I ont fourni des mesures discriminantes. L'une est une phalange antérieure qui appartiendrait à un âne (Fig. 29.10) et l'autre est une phalange postérieure qui pourrait appartenir à un âne de grande taille ou à une mule (Fig. 29.11).

D'autres éléments des membres ont été identifiés au rang de l'espèce à partir de critères morphologiques (Peters 1998). Le tibia distal (NR=10 ; NMI=7)⁶ a une forme trapézoïdale. Contrairement à la forme rectangulaire caballine, la forme trapézoïdale du distum est asinienne. La Figure 29.12 montre que pour la largeur et l'aplatissement (la largeur divisée par la profondeur: mesure 7/mesure 8) de l'articulation distale, la majorité de nos spécimens se trouve dans la variabilité de l'âne. Le distum qui présente les plus grandes valeurs pour la largeur et pour le rapport entre la largeur et la profondeur de l'articulation, se trouve à des valeurs proches de celles du cheval et de la mule. Nous ne pouvons exclure son appartenance à l'un de ces deux équins.

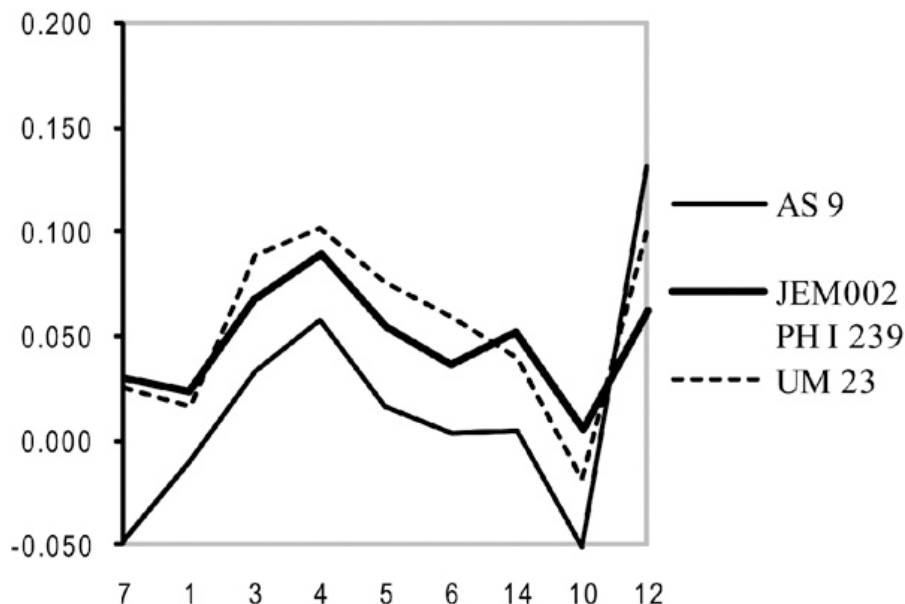


Fig. 29.11. Diagramme de différence en logarithme des mesures de la phalange I (239) de JEM002 et de la phalange I postérieure de l'âne (AS9) et de la mule (UM23). L'espèce de référence est l'hémione (données métriques: <http://vera-eisenmann.com>).

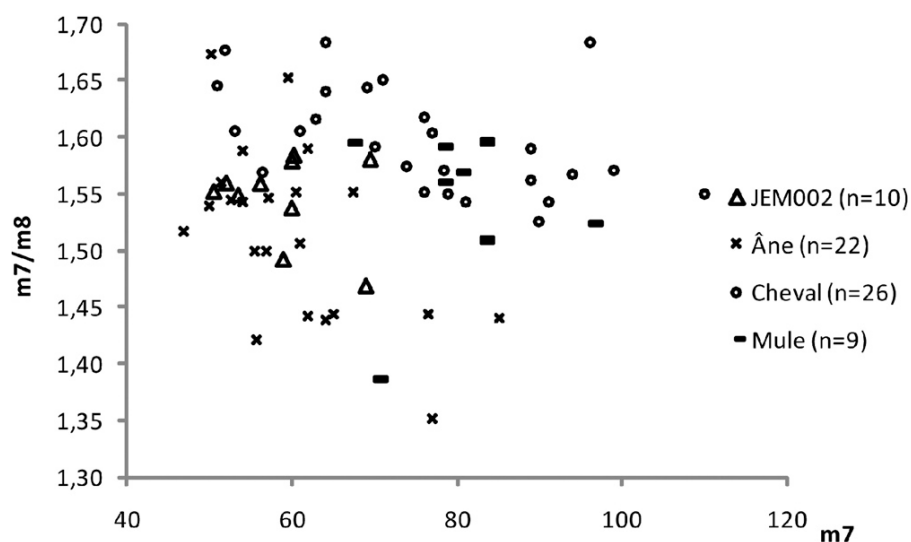


Fig. 29.12. Diagramme bivarié de la largeur (mesure 7) et de l'indice d'aplatissement du tibia distal (mesure 7/mesure 8) des équidés de JEM002, comparés à l'âne, au cheval et à la mule (données métriques: <http://vera-eisenmann.com>).

La discrimination spécifique a ainsi montré que la majorité des

restes d'équidés appartiennent à l'âne, notamment les dents jugales. Un crâne pourrait provenir d'un cheval ou d'une mule. Le squelette postcrânien provient aussi d'individus asiniens et d'un cheval. L'appartenance d'un métacarpe et d'une phalange à la mule n'est pas exclue.

Estimation de l'âge

Les incisives étant pour la plupart isolées, nous avons établi le profil de mortalité des équidés à partir du stade de développement des racines et de l'attrition des dents jugales. Le début du processus de formation des racines des dents jugales correspond à l'âge auquel l'émail est minéralisé et au moment où la dent atteint sa hauteur maximale (Hoppe *et al.* 2004). En se basant sur l'âge relatif aux stades de minéralisation des dents permanentes avancé par Hoppe *et al.* (2004), nous avons estimé l'âge des séries dentaires qui contiennent des dents dont les racines ne sont pas encore formées. La P2 et la M2 supérieures, la P3 et la M2 inférieures qui présentent la plus grande hauteur dans notre échantillon pour ces catégories de dents, se trouvent dans des rangées dentaires incluant des dents dont les racines ne sont pas encore formées et dont l'âge a été bien défini. Ainsi nous avons pu déterminer la hauteur maximale de ces dents au sein de notre échantillon. Nous avons ensuite divisé, à l'instar de Vila (1998⁷), la hauteur maximale de chaque catégorie de dent par quatre pour définir des intervalles de hauteur de la couronne auxquels correspond un âge réel (Table 29.2 et 29.3).

Table 29.2. Répartition des classes d'âge en fonction de la hauteur de la P2 et de la M2 supérieures des équidés de JEM002. Les intervalles de hauteur de la couronne définissent les classes d'âge. La hauteur maximale correspond à la classe d'âge de 2.5/3–5 ans. Les trois quarts de la hauteur maximale correspondent à la classe d'âge de 5–9 ans. La moitié de la hauteur maximale correspond à la classe d'âge de 9–13 ans et le quart correspond à la classe d'âge de 13 ans et plus. Les effectifs des classes d'âge sont corrigés en fonction de la classe qui s'étend sur la plus courte durée.

Âge (ans)	Coefficient de correction	P2	M2
2.5	× 1	55.6	
3			80.4
5	× 1	41.7	60.3
9	× 0.5	27.8	40.2
13	× 0.5	13.9	20.1
	× 0.3		

Le profil de mortalité, ainsi construit, montre que la majorité des individus appartient aux classes d'âge entre deux ans et demi et treize ans (Fig. 29.13). Un individu a moins de deux ans et un autre a plus de treize ans. Ces résultats obtenus à partir d'un référentiel basé sur la minéralisation des dents des chevaux sont à prendre avec précaution dans la mesure où notre assemblage est dominé par l'âne et que le développement et l'attrition des dents se déroulent à des rythmes différents entre l'âne et le cheval (Hoppe *et al.* 2004; Misk et Seilem 1997; Muylle *et al.* 1999). D'après Misk et Seilem (1997) la formation des racines des dents jugales supérieures de l'âne se fait dans l'ordre suivant: M1, M2, M3, P2, P4, P3 et celle des dents inférieures dans cet ordre: M1, M2, M3, P2 et P3, P4 (Misk et Seilem 1997, tab. 2, 32). Ces données contredisent nos observations sur les ânes de JEM002 chez qui les racines des dents jugales supérieures et inférieures se développent en premier au niveau de la M1, puis la P2, P3, M2, P4 et enfin la M3. La séquence de formation des racines établie par Misk et Seilem (1997) ne convient donc pas à notre assemblage. Nous avons retenu tout de même l'âge de cinq ans marquant la fin du processus de formation des racines ainsi que la corrélation entre les séquences d'usure et les âges correspondants proposée par ces auteurs (figs 1–16, 28–31) afin de vérifier la répartition par âge établie pour notre échantillon. A l'issue de l'adaptation de cette méthode à notre assemblage, il s'avère que le profil de mortalité ne change pas de manière significative, hormis l'élargissement de la première classe d'âge lié à l'impossibilité d'utiliser les séquences de formation des racines⁸.

Table 29.3. Répartition des classes d'âge en fonction de la hauteur de la P3

et de la M2 inférieures des équidés de JEM002. Les intervalles de hauteur de la couronne définissent les classes d'âge. La hauteur maximale correspond à la classe d'âge de 3–5 ans. Les trois quarts de la hauteur maximale correspondent à la classe d'âge de 5–9 ans. La moitié de la hauteur maximale correspond à la classe d'âge de 9–13 ans et le quart correspond à la classe d'âge de 13 ans et plus. Les effectifs des classes d'âge sont corrigés en fonction de la classe qui s'étend sur la plus courte durée.

<i>Âge (ans)</i>	<i>Coefficient de correction</i>	<i>P3</i>	<i>M2</i>
	× 1		
3		74.4	80.25
	× 1.5		
5		55.8	60.19
	× 0.75		
9		37.2	40.13
	× 0.75		
13		18.6	20.06
	× 0.25		

Sex-ratio

Nous complétons l'approche démographique par l'estimation du sex-ratio. Sur les 23 individus représentés par des dents jugales inférieures, seulement neuf présentent des diastèmes intacts permettant l'évaluation de la présence et du développement des canines. Dans cet échantillon, huit spécimens sont caractérisés par un développement important des canines, ce qui permet leur attribution à d'individus mâles. Le dernier spécimen dépourvu de canine est une femelle. Par ailleurs, sept canines isolées sont issues de mâles, ce qui donne un sex-ratio de 15 mâles pour une femelle. Si nous avons compté 15 canines bien développées sur un total de 23 individus, la forte fragmentation des diastèmes ne permet pas d'exclure la présence d'autres femelles. Néanmoins les mâles demeurent dominants avec au moins 15 individus sur 23.

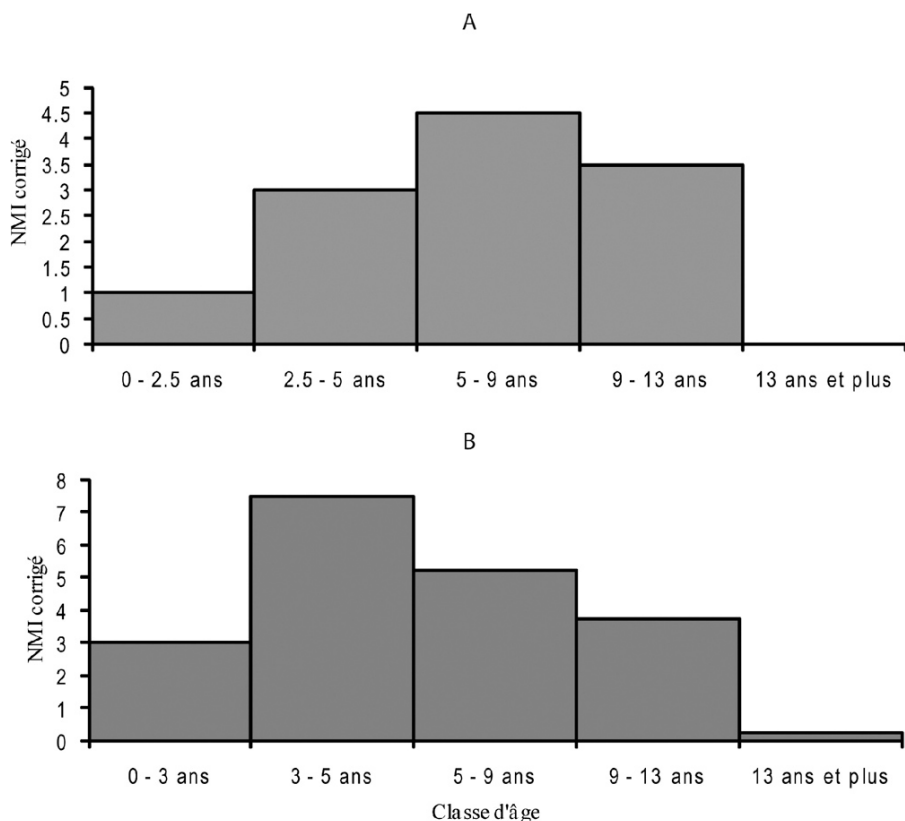


Fig. 29.13. A. Le profil de mortalité en NMI corrigé des équidés de JEM002 construit à partir des âges estimés sur les dents jugales supérieures (NMI=20); B. Le profil de mortalité en NMI corrigé des équidés de JEM002 construit à partir des âges estimés sur les dents jugales inférieures (NMI=21).

Par ailleurs, la combinaison des données relatives à l'âge et au sexe souligne que le seul individu sénile est une femelle.

Stature et gracilité

Comparés à des données issues de quelques sites du Proche-Orient, les ânes de JEM002 se placent parmi les grands individus. La [Figure 29.14](#) illustre la largeur du tibia distal des ânes de JEM002, ceux de Sagalassos (I^{er}– VI^{ème} siècle ap. J.-C.; De Cupere 2001), de Kamid el-Loz (Âge du Bronze récent et Âge du Fer; Bökönyi 1990) et de Tell Jennin (Âge du Bronze Ancien; Al-Zawahra et Ezzughayyar 1998). Les ânes de JEM002 sont de grande taille, mais ils ne diffèrent de manière significative que des spécimens de l'Âge du Bronze récent de Kamid el-Loz (test t, $P=0.01$).

La hauteur au garrot de l'âne de JEM002, estimée sur la phalange I

(221), est de 1.19m.

Le cheval de JEM002 aurait une hauteur au garrot de 1.27m, estimée sur le métacarpe, selon le coefficient appliqué au cheval de Przewalskii et au cheval arabe. Il aurait 1.43m au garrot selon le coefficient appliqué au cheval de trait (Willoughby 1974; Eisenmann <http://vera-eisenmann.com>⁹). L'indice de gracilité¹⁰ calculé pour le métacarpe est de 15.3. Comparé aux chevaux de la Gaule romaine (Lepetz 1996), le cheval de JEM002 se situe parmi les individus robustes.

Pathologies osseuses

Les équidés de JEM002 sont atteints de pathologies osseuses notamment au niveau des vertèbres et des côtes. Les membres sont peu affectés ; une seule pathologie a été relevée au niveau d'un métacarpe. Des pathologies orales ont été aussi observées.

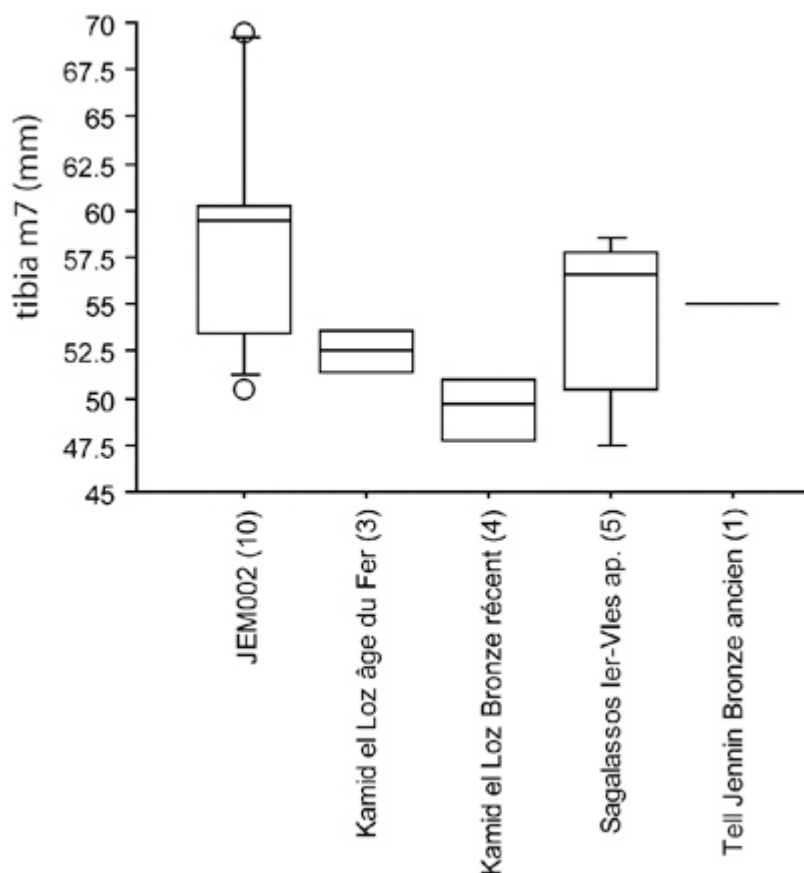


Fig. 29.14. La largeur de l'articulation distale du tibia (mesure 7) des ânes de JEM002, comparés à ceux de Sagalassos (Ier– VIème siècle après J.-C.;

De Cupere 2001), de Kamid el-Loz (Âge du Bronze récent et Âge du Fer; Bökönyi 1990) et de Tell Jennin (Âge du Bronze ancien; Al-Zawahra et Ezzughayar 1998). La différence de taille est significative entre JEM002 et l'Âge du Bronze de Kamid el-Loz (test t, $P = 0.01$).

LA CAGE THORACIQUE

Les trois régions de la colonne vertébrale sont affectées de pathologies. Cependant peu de vertèbres, par rapport au nombre total, présentent des anomalies (16 sur un total de 288). La fragmentation a limité la possibilité de déterminer le nombre d'individus affectés.

Deux vertèbres cervicales isolées témoignent d'anomalies. L'une présente une malformation ou une cicatrisation suite à une fracture au niveau du processus articulaire. L'autre présente un développement d'un nouveau tissu osseux au niveau du tubercule ventral du processus transverse.

Sept vertèbres thoraciques isolées sont pathologiques. De l'exostose s'est développée sur la face ventrale des corps vertébraux (NR=3) et des ostéophytes ont proliféré sur la face ventrale de la tête articulaire et du disque vertébral caudal (NR=2). De l'exostose s'est formée au niveau d'un processus épineux. Enfin, une vertèbre présente une fissure horizontale au niveau du disque vertébral caudal.

Un ensemble en connexion anatomique composé de quatre vertèbres thoraciques et une côte présente des pathologies. Des ostéophytes se sont formées sur la face ventrale du disque vertébral caudal et autour de la tête articulaire. Le bord caudal du processus épineux présente du *lipping*. Une vertèbre montre une résorption de l'os sous forme de cupules (*pitting*) au niveau du corps vertébral et du processus épineux. Une tête articulaire présente une zone de dépression (Fig. 29.15; Bendrey *et al.* 2008). La côte présente un développement d'un nouveau tissu osseux sur la face viscérale et externe.



Fig. 29.15. Vue crâniale d'une vertèbre thoracique d'équidés montrant une zone de dépression au niveau de la tête articulaire.

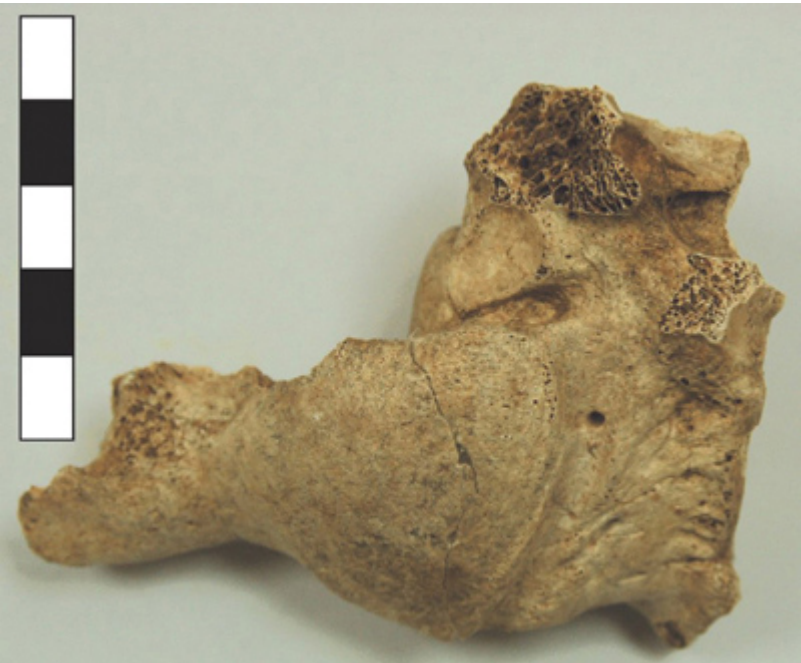


Fig. 29.16. Vue latérale d'une vertèbre d'équidés montrant une formation d'ostéophytes sur le corps vertébral.

Deux vertèbres lombaires présentent des exostoses. Deux autres vertèbres sont soudées, résultant d'une spondylose déformante (Fig.

29.16). Des anomalies sont observées au niveau de trois côtes isolées. Deux présentent une formation d'un nouveau tissu osseux avec des zones de destruction de l'os en forme de cupules. Enfin, une côte est soudée à la dernière vertèbre cervicale.

Les pathologies observées pourraient provenir de causes naturelles ou de l'exploitation des animaux par l'homme. Pour élucider l'étiologie de ces pathologies, nous tenterons de nous prévaloir de la structure de l'âge de l'échantillon affecté. Les ostéophytes qui ont proliféré sur les surfaces périarticulaires et l'exostose au niveau du processus épineux peuvent être liés à l'âge, à une anomalie congénitale ou à une mauvaise répartition du poids sur le dos de l'animal (Levine *et al.* 2000; Arbogast *et al.* 2002). Ces anomalies sont observées chez de vieux individus d'équidés sauvages âgés de 27 ans mais elles sont absentes chez les plus jeunes âgés de 12 ans (Bendrey 2007). Les équidés de JEM002 étant relativement jeunes, ces pathologies seraient plutôt causées par un poids agissant sur le dos des animaux. Aussi, les lésions sur le disque vertébral caudal des vertèbres thoraciques sont dues au poids exercé sur le dos de l'animal qui agit directement sur le processus épineux (comme le poids du cavalier) ou à la conduite d'un char dans le cas du cheval (Levine *et al.* 2000; Levine 2004). Enfin, la dégénérescence des disques intervertébraux résultant en une spondylose déformante a lieu suite à des microfractures des corps vertébraux (Mikliková 2008; Rossel *et al.* 2008).



Fig. 29.17. Vue linguale de la P3 droite du crâne 36 montrant un renflement de la couronne.

En outre, les destructions de l'os sous forme de petites cupules (*pitting*) au niveau des vertèbres et des côtes et le développement d'un nouveau tissu osseux pourraient résulter d'une maladie infectieuse (Bendrey 2008).

LE MÉTACARPE

Un métacarpe présente de l'exostose au niveau de l'extrémité proximale et une ossification des ligaments inter – osseux entre le canon et le deuxième métacarpe vestigial. Cette fusion des métacarpes survient généralement avec l'âge (Bendrey 2007). Cependant, les animaux de JEM002 étant pour la majorité jeunes, cette pathologie pourrait être due à une répétition de mouvements qui endommage les ligaments et le périoste des os (Bertone 2002). Elle résulterait donc de l'exploitation de l'animal.

En ce qui concerne les pathologies orales, une P2 inférieure présente une usure irrégulière où le bord mésial est peu usé par rapport à la partie distale de la dent. L'os sous-jacent présente des perforations d'origine infectieuse. Une autre anomalie orale se présente sous la forme d'un renflement de la couronne d'une P3 supérieure (Fig. 29.17).

Par ailleurs, des pathologies sont observées au niveau du corps mandibulaire. Certaines mandibules présentent des exostoses et du *pitting*. Des plages de destruction de l'os chez un jeune individu de deux ans et demi résulteraient d'infections plutôt que de l'âge.

Caractérisation taphonomique de l'assemblage

L'examen des traces d'origine anthropique sur les os et la fréquence des éléments du squelette fait ressortir des différences dans le traitement des carcasses des équidés, d'une part, et des espèces de la triade, d'autre part.

Les traces observées sur les os des équidés se présentent sous forme d'incisions fines et de cupules. Ce sont des stigmates laissés par le dépouillement, la désarticulation et le prélèvement de tendons et de la viande. Les traces de dépouillement sont localisées sur la phalange I (un spécimen sur trois). Les traces de désarticulation se trouvent sur le talus (quatre spécimens sur huit) et le calcanéum (sept spécimens sur onze). Le prélèvement de tendons a laissé des traces sur le métacarpe (un spécimen sur trois). Trois os coxaux (sur un total de quatorze), 11 dix côtes (sur un total de 214), quatre vertèbres (sur un total de 288) et une mandibule témoignent du prélèvement de la viande.¹²

Cette découpe est faite au couteau comme le révèlent les types de traces. L'utilisation du couperet est attestée sur une côte. Ceci témoigne du dépeçage de la cage thoracique. Toutefois les traces laissées sur les os sont rares; seulement 3% des os d'équidés portent des traces de découpe.¹³ Sur des sites médiévaux en France, où l'hippophagie est attestée, 7.1 à 8.6% des os d'équidés portent des traces de découpe, contre 10 à 20% pour le bœuf (Yvinec 1999). Dans notre échantillon, 63% des os de bœuf portent des impacts de découpe. Ainsi, par rapport à la fréquence des traces de découpe sur les os de bœuf, les stigmates relevés sur les os des équidés de JEM002 s'avèrent être occasionnels.

A l'opposé, les traces de découpe observées sur les os du bœuf soulignent la multitude d'impacts d'outils, tout particulièrement du couperet. Les gestes du boucher sont stéréotypés suggérant une normalisation de la découpe. Par exemple, l'humérus porte des traces

de décarnisation sur les quatre faces avec une récurrence des traces de raclage et d'incisions à l'emplacement des muscles grand rond et grand dorsal sur la face médiale (cinq humérus sur huit). Des récurrences de percussions au couperet et des traces de raclage sont localisées aussi sur la face crânio-médiale de l'os à l'emplacement du muscle brachio-céphalique (six humérus sur huit; Barone 1976).

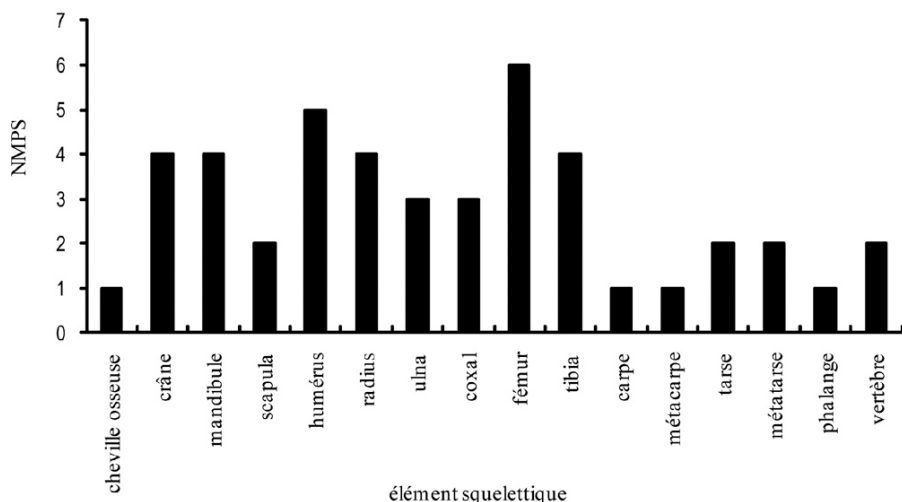


Fig. 29.18. Fréquence des éléments du squelette des bovinés en Nombre Minimal de Parties Squelettiques (NMI = 6).

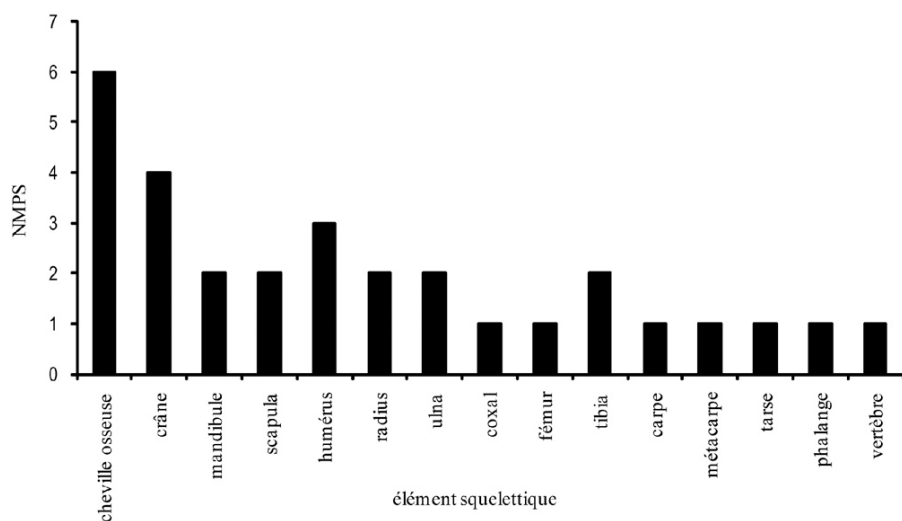


Fig. 29.19. Fréquence des éléments du squelette des caprinés en Nombre Minimal de Parties Squelettiques (NMI = 6).

Le petit bétail fait également l'objet d'un dépeçage au couperet et

d'un désossage au couteau. Nous sommes en présence de techniques de transformation très différentes de celles qui sont pratiquées sur les carcasses d'équidés. Il est remarquable de constater que des animaux de même format comme les caprinés et le porc fassent l'objet d'une découpe similaire, tandis que les équidés et le bœuf, de gabarit proche, se singularisent par une technique de découpe différente.

Concernant la répartition des éléments du squelette, les animaux de la triade sont représentés principalement par la tête osseuse et les membres (à part la scapula de bœuf). Les extrémités, les côtes et les vertèbres sont moins fréquentes (Figs. 29.18–29.20). Les équidés sont essentiellement représentés par la tête osseuse, le membre postérieur, les côtes et les vertèbres. Le membre antérieur et les extrémités sont peu représentés. Le métatarse et les os tarsiens distaux sont absents (Fig. 29.21).

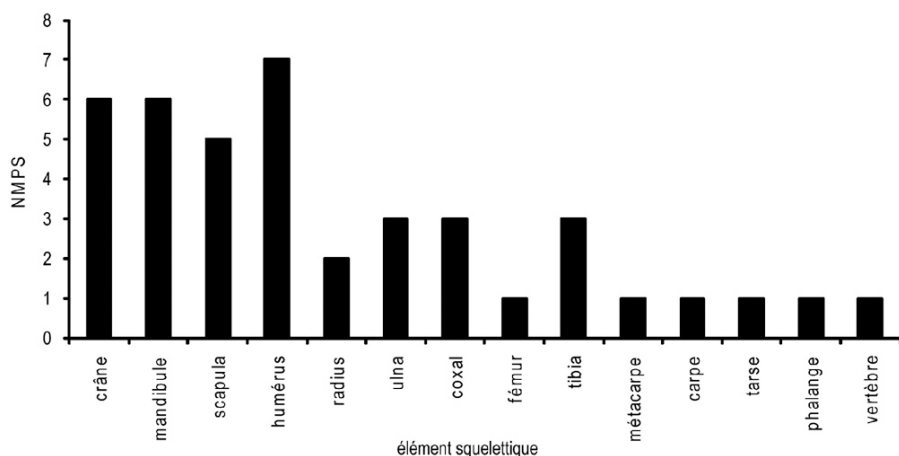


Fig. 29.20. Fréquence des éléments du squelette des suinés en Nombre Minimal de Parties Squelettiques (NMI = 7).

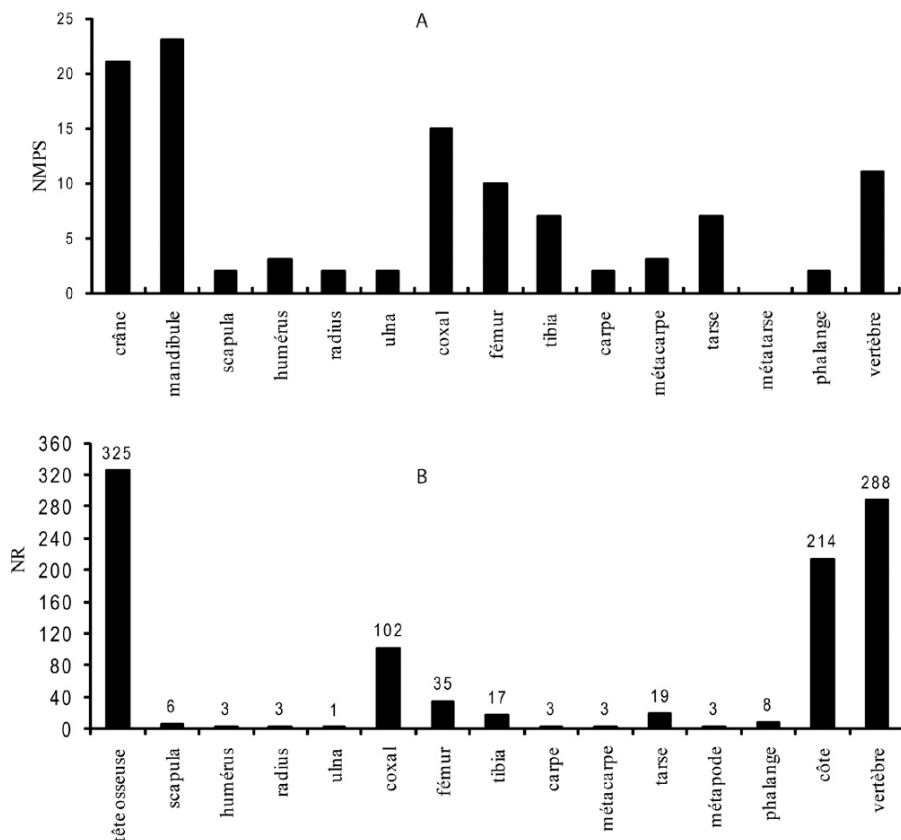


Fig. 29.21. Fréquence des éléments du squelette des équidés (NMI = 23). A: en Nombre Minimal de Parties Squelettiques; B: en Nombre de Restes.

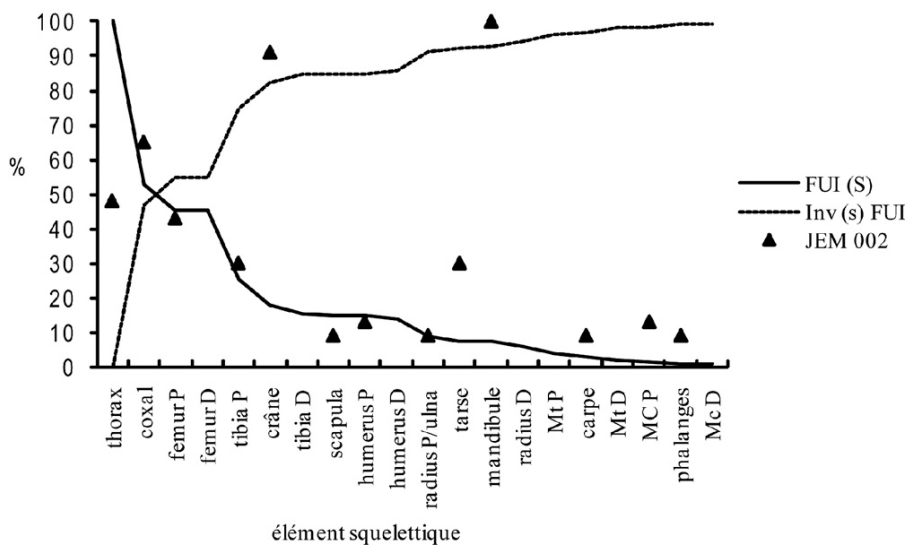


Fig. 29.22. Comparaison de la fréquence en NMPS des éléments du squelette des équidés exprimée en pourcentage de la plus haute valeur avec le (S) FUI (données d'après Outram et Rowley-Conwy 1998) et le FUI inverse. Les éléments sont placés sur l'axe des abscisses en ordre décroissant de FUI (Outram 2006). Les éléments squelettiques de JEM002 ne sont pas répartis en partie proximale et distale pour les os longs, nous les avons placés sur le graphique au niveau des parties proximales.

Il ressort ainsi des différences dans le rejet des éléments de la carcasse entre les équidés et les autres taxons. Ceci suggère qu'au moment de la formation de ce dépotoir, nous sommes à des stades différents de la transformation des matières premières animales; les déchets issus des espèces de la triade d'une part et des équidés d'autre part relèvent d'activités différentes.

La technique de découpe et la répartition des éléments du squelette des animaux de la triade suggèrent que nous sommes en présence de déchets de boucherie. Les membres désossés, comme en témoignent les traces de découpe, et la tête sont rejetés à l'issue de cette opération. Le déficit au niveau du rachis suggère qu'il serait vendu au détail en portions de viande à l'os (Nin et Leguilloux 2003).

La répartition des éléments squelettiques des équidés ne relève pas de rejets de boucherie. Elle n'est pas non plus caractéristique des déchets de consommation (Fig. 29.22). La fréquence des éléments squelettiques suggère que tout le squelette est présent, à l'exception du membre antérieur et des bas de pattes qui ont été prélevés.

A la différence observée au niveau des traces de découpe et de la répartition des éléments du squelette, vient s'ajouter la présence de connexions anatomiques exclusivement dans le cas des équidés (Figs 29.23 et 29.24). Plusieurs trains de vertèbres et de côtes sont restés soudés (NR = 10).

Du point de vue taphonomique, les os n'ont pas subi l'intempérisation en surface. Aussi, les traces d'intervention d'animaux charognards et commensaux comme le mâchouillement, les traces de griffes et de charriage sont très rares. Les traces de racines sont tout aussi rarement observées. Seulement 0.9% des os portent des traces d'origine climatique et biologique. Les altérations post-enfouissement résultent surtout de la nature argileuse du sol. La variation saisonnière de l'humidité a dû entraîner la dilatation et la rétraction de l'argile, ce qui aurait fragilisé les os. Ainsi les crânes, les côtes et les vertèbres, de morphologie complexe, sont les éléments les plus fragmentés.



Fig. 29.23. Détail du dépotoir de JEM002. Vertèbres thoraciques et côtes d'équidés en connexion anatomique.



Fig. 29.24. Détail du dépotoir de JEM002. Vertèbres cervicales d'équidés en connexion anatomique.

Discussion

Ce dépotoir a été constitué par l'élimination de déchets osseux encombrants et leurs rejets à l'extérieur des murailles, dans une zone accueillant divers rebuts générés par la ville. La prédominance des restes équins est caractéristique de cet ensemble. Elle suggère une spécialisation des activités qui ont eu lieu à proximité de cette zone de

décharge.

Les équidés sont représentés surtout par des ânes. Du point de vue démographique, il s'agit essentiellement de mâles adultes, soit des individus adaptés au portage et à la traction. En effet, historiquement, comme aujourd'hui, ces animaux sont initiés aux différentes tâches à partir de l'âge de trois ans (Varron IV, 2, 6).

Cette sélection des individus suggère que ces animaux sont fortement impliqués dans l'économie de la ville. Les sources antiques nous apprennent que l'âne est utilisé pour tourner la meule, pour le transport dans les travaux agricoles et aux labours des terres légères (Varron, *De Rustica* II, 6, 5). D'après Varron (*De Rustica*, II, 8, 5), il n'est pas utilisé pour le transport des passagers, rôle qui est assuré par la mule. Les sources nous renseignent aussi qu'un plus grand nombre d'ânes est requis pour le transport des denrées que pour le moulin, alors que le labourage est l'activité qui nécessite le moins d'animaux. Les troupeaux d'ânes ne sont constitués que pour les transports commerciaux (Caton, *De Agricultura*, XI-XII). Dans ce témoignage, l'effectif des ânes nécessité pour chaque tâche n'est pas précisé. Dans l'assemblage de JEM002, le nombre d'individus peut être considéré relativement élevé. En outre, les pathologies osseuses sont associées à la surcharge des animaux dans le cadre de leur utilisation. Ainsi, il est vraisemblable que ces animaux, ou un certain nombre d'entre eux, aient été utilisés comme bêtes de somme.

Le cheval de JEM002, vu sa robustesse, a probablement été réservé à des tâches de portage ou de traction dans le cadre des activités économiques urbaines ou dans le cadre des échanges commerciaux.

Certains sites archéologiques attestent de la sélection des équidés en fonction de leur âge, leur sexe ainsi que leur gabarit. Dans le fort militaire romain de Carnuntum (Kunst 2000), les chevaux et les mulets sont tous des mâles, âgés pour la plupart entre cinq et neuf ans¹⁴ et de taille correspondant à la partie supérieure de la variabilité connue dans la région. Dans un autre contexte, l'écurie de la maison de Casti Amanti à Pompéi (Genovese et Cocca 2000), quatre ânes et un mulet mâles, utilisés comme bêtes de somme, sont âgés de quatre à neuf ans. La sélection des animaux semble être en rapport avec leur utilisation ; les équidés mâles appartenant à la tranche d'âge de quatre à neuf ans sont régulièrement exploités. A JEM002, les mâles sont bien attestés mais la fourchette d'âge est plus étalée. L'exploitation à plus long terme expliquerait le fait que des sujets soient atteints de pathologies, contrairement aux ânes sains de Casti Amanti.

D'autre part, l'exploitation de la viande des équidés est probable. Toutefois les carcasses équinées ne relèvent pas pour autant de la

même chaîne opératoire que le bœuf, les caprinés ou le porc. Par ailleurs, les données issues du site Bey002¹⁵ révèlent que la viande des équidés est consommée de l'époque hellénistique jusqu'au début de l'époque romaine impériale (Oueslati 2004). Les traces de découpe observées sur ce site combinent les incisions fines laissées par le couteau et les impacts de couperet réservés au dépeçage de la carcasse. Les traces observées sur les os des équidés de JEM002 sont plus discrètes. Nous pouvons envisager dans ce cas une consommation opportuniste de la viande équine, prélevée directement sur les carcasses. D'autres contextes archéologiques témoignent de cette dualité des techniques de boucherie avec une prédominance du désossage qui se pratique au couteau et une fragmentation limitée des os (Yvinec 1999; Oueslati 2006).

En outre, les carcasses des équidés ont fait l'objet d'un prélèvement de matière première comme la peau, les tendons et certains os. Le membre antérieur et les extrémités, en déficit par rapport aux autres éléments du squelette, seraient transportés pour être transformés ailleurs, soit pour la viande soit pour la tabletterie. L'utilité de la scapula, du radius et des métapodes est connue pour l'artisanat de l'os (Arbogast *et al.* 2002). A cet effet, la désarticulation au niveau du talus et du calcanéus expliquerait l'absence des os tarsiens distaux et du métatarse.

Si notre assemblage n'a pas livré de rebuts issus d'os d'équidés, une accumulation contemporaine vient nous renseigner sur le tronçonnage de matière première. Il s'agit de rebuts liés au prélèvement de la diaphyse des métatarses de bœuf et d'équidés sous forme d'extrémités articulaires sciées, ainsi que des os de la rangée distale du tarse d'équidés (os naviculaire, cuboïde et grand cunéiforme). Cette accumulation, mise au jour sur le même secteur de la fouille, se caractérise également par une carbonisation totale de ces déchets qui ont été probablement utilisés comme combustible¹⁶. A ce témoignage du travail des os d'équidés et de bovins attesté sur notre site, nous pouvons associer d'autres accumulations découvertes *intra muros* notamment sur le site BEY002 où les rebuts de façonnage d'objets en os ont été mis au jour (Oueslati 2004). Ainsi la mise en évidence d'étapes situées plus en amont de la chaîne opératoire de transformation de l'os à l'extérieur de la ville et sur des carcasses équines partiellement exploitées n'est pas sans évoquer l'activité contemporaine de l'équarrissage. Une activité équivalente pourrait être à l'origine des stigmates laissés sur les os, notamment dans le cadre du dépouillage, et du déficit d'autres parties du squelette recherchées par les tabletiers. Ces derniers recherchent également des

os de camélidés comme l'atteste une articulation radio-ulnaire proximale sciée dans notre assemblage.

D'un point de vue taphonomique, l'enfouissement des os s'est fait avant la décomposition totale des ligaments puisque des segments de vertèbres et de côtes sont restés en connexion anatomique. Cependant le dépôt est formé majoritairement d'éléments isolés. En l'absence de traces de désarticulation au niveau des membres et de la quasiabsence de traces d'intervention d'animaux commensaux, la dislocation des liens anatomiques pourrait être expliquée par deux faits distincts. Soit la carcasse a été désarticulée sans que ce processus n'ait laissé de stigmates sur les os. Soit le dépotoir a été généré par la remobilisation de déchets initialement accumulés dans un autre locus avec des carcasses partiellement décomposées. La cage thoracique, dont certaines connexions ont été préservées, est la partie du squelette dont les ligaments mettent le plus de temps à se décomposer (Hill et Behrensmeyer 1984).

Les cas de remobilisation de carcasses où certains ensembles anatomiques, notamment la colonne vertébrale, sont restés en connexion sont connus dans la littérature. Méniel (2008) interprète les amas osseux mis au jour dans les enclos de certains sanctuaires comme des dépôts secondaires issus de sacrifices d'animaux dont les carcasses ont été exposées et partiellement décomposées avant qu'elles ne soient transportées dans un ossuaire, en l'occurrence, un fossé d'enclos ou une fosse. Une intervention anthropique de ce type pourrait expliquer les caractéristiques de l'accumulation du site JEM002. L'absence de traces de désarticulation pourrait être expliquée par le fait qu'à l'issue du prélèvement des matières premières, certains membres sont restés en connexion. Puis, après leur décomposition partielle, les os seraient évacués dans cette zone de décharge. Dans ce cas, le temps de décomposition au niveau du dépôt primaire a été suffisamment bref pour que la colonne vertébrale ne soit complètement disloquée.

Du point de vue archéologique, la remobilisation de déchets peut être en relation avec l'assainissement d'une zone en vue de l'aménager pour de nouvelles fins. Le développement des constructions, comme en témoigne l'extension ultérieure de la ville (A. Seif et F. Béaino, comm. pers. 2009), pourrait être en relation avec la nouvelle gestion spatiale des déchets.

Ainsi, ce dépotoir nous renseigne sur la transformation des ressources animales et la gestion des déchets à Berytus. A l'échelle de la ville, la composition de cette accumulation est différente de celle des dépotoirs *intra muros* où les déchets sont surtout issus de la

consommation et où abondent les caprinés, le bœuf, le porc et les restes de poissons (Rackham 1996; Oueslati 2008). Cette différence vient du fait que nous sommes loin de la zone d'habitations qui génèrent des déchets culinaires. La concentration de carcasses d'équidés en un locus près des remparts est produite par l'équarrissage qui génère un gros volume de déchets dont l'évacuation à l'extérieur de la ville paraît inévitable. Ce dépotoir a accueilli aussi des déchets de boucherie issus de caprinés, du porc et notamment du bœuf. Ce dernier fait l'objet d'une boucherie artisanale de production de masse. Ce traitement de la carcasse privilégie la rapidité de la découpe et génère une grande quantité de déchets (Oueslati 2006). Cette technique est connue à l'époque romaine et est diffusée dans de nombreuses provinces de l'empire (Maltby 1985; Wilkens 1997; Yvinec 1993; Oueslati 2004). Les dépotoirs typiques qui en résultent sont issus d'un traitement d'un grand nombre de bovins parfois atteignant plusieurs milliers d'individus (Oueslati 2005). Il en découle ainsi que le caractère spécialisé de l'accumulation de JEM002 est en rapport avec une exploitation non domestique des ressources animales telle que la boucherie, l'équarrissage et la tabletterie.

Conclusion

La prédominance de l'âne dans le dépotoir de JEM002 montre que cet animal faisait partie du paysage quotidien de Berytus où il devait jouer un rôle important dans l'approvisionnement de la ville et tout particulièrement dans le transport des denrées. Les mortalités survenues parmi ces bêtes de somme ont nécessité leur évacuation à l'extérieur de la ville. Notre dépotoir situé *extra muros* illustre l'accumulation de ces carcasses. Leur analyse taphonomique a révélé une exploitation partielle de la peau, de la viande et le prélèvement de matière première pour la tabletterie. Contrairement au bœuf, les traces relevées sur les os d'équidés se sont avérées rares soulignant des traitements distincts des deux animaux. Il est tentant d'associer les restes d'équidés mis au jour dans notre dépotoir avec des déchets issus de l'équarrissage, activité bien documentée à des périodes plus récentes. Mêlés à cette accumulation spécialisée, se trouvent différents témoignages de déchets de boucherie d'autres espèces moins abondantes qui ont permis de confirmer l'introduction des nouvelles techniques de découpe romaines à Berytus.

Du point de vue archéologique, cette zone périphérique de Berytus a été utilisée au début du I^{er} siècle pour disposer des déchets issus des diverses activités économiques de la ville. L'extension de Berytus à la fin de ce siècle modifiera la fonction de l'emprise du site qui se trouve

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Notes

1 Le site a été fouillé dans le cadre d'une opération de sauvetage dirigée par M. Assaad Seif (Direction Générale des Antiquités, Liban) entre mai 2005 et août 2008.

2 La densité et l'enchevêtrement de ces vestiges ont justifié un carroyage de la zone de fouille et les déblais ont été intégralement tamisés sur des mailles de 5mm et 0.5mm. Ce matériel a été étudié par Y. Hourani en 2009 au cours de son master au Muséum national d'Histoire naturelle de Paris en collaboration avec le laboratoire d'Archéozoologie de Lille

3. Les tests d'invertébrés ne sont pas inclus dans cette étude.

3 NMI: Nombre minimal d'individus (Poplin 1976; Grayson 1984: MNI)

4 La somme de la longueur et de la largeur occlusales divisée par deux.

5 Les différentes opinions sur le caractère discriminant du cornet des incisives sont présentées dans Eisenmann (1979).

6 NR: Nombre de Restes (Poplin 1976; Grayson 1984: NISP)

7 Vila utilise les données de Levine (1982) pour définir l'âge auquel la couronne de la dent est usée au quart, à la moitié et aux trois-quarts.

8 Pour comparer la structure de l'âge de notre échantillon d'équidés aux données relatives à l'attrition des dents jugales chez l'âne, nous avons comparé nos spécimens aux radiographies des dents et à l'âge correspondant présentés par Misk et Seilem (1997). Les classes d'âge définies sont ainsi très relatives. La première classe d'âge s'étale de 0 à 5 ans et regroupe tous les individus présentant au moins une dent n'ayant pas les racines formées. Entre 5 et 8 ans toutes les dents ont des racines et la couronne est moyennement réduite. Entre 8 et 15 ans, sont regroupées les dents dont la couronne est bien réduite et dont les racines sont longues par rapport à la hauteur totale de la dent. Enfin, âgées de 15 ans et plus sont les dents dont la partie enchâssée dans l'os est complètement sortie et dont la couronne est très réduite, seules les racines sont encastrées.

9 <<http://vera-eisenmann.com/withers-height-estimationsarticle001268.html>

10 L'indice de gracilité est le rapport du diamètre transverse à la longueur de la diaphyse: $\text{diamètre transverse minimal de la diaphyse} \times 100 / \text{longueur totale}$

11 Les traces de découpe sur le bassin sont localisées sur la crête de la tubérosité ischiatique donc nous n'avons pris en considération que les fragments d'os coxaux où cette partie de l'ischium est présente pour déterminer la fréquence des traces de découpe. Les traces sont observées sur le côté droit dans les trois cas.

12 Le fémur, le tibia et l'humérus portent des traces anecdotiques, de fines et courtes stries. Nous n'avons pas pu conclure qu'il s'agissait de traces de découpe, même après leur observation au stéréomicroscope.

13 Nous n'avons pas pu investiguer d'éventuelles traces d'abattage en raison du mauvais état de conservation des crânes. La fragmentation de ces éléments a nécessité une consolidation au moment de la fouille. Le sédiment mêlé à la colle a rendu impossible l'observation d'impacts d'outils sur les crânes.

- 14 La fréquence de cette classe d'âge est connue dans d'autres contextes militaires romains. Pour plus de détails se référer à Kunst (2000).
- 15 Site fouillé en 1994 par l'Institut Français du Proche-Orient et situé au centre-ville actuel de Beyrouth et au cœur du centre antique de la ville.
- 16 Cette accumulation fera l'objet d'une étude ultérieure.

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30. The animal bone remains from Mar Nicola, a Byzantine–Islamic site at Beit Jala, Palestine

Mohammad Al-Zawahra

This report deals with the faunal remains that have been collected at the site of Mar Nicola, located in the centre of Beit Jala, 2km northwest of Bethlehem (Palestine). The majority of the animal bone assemblage represents two taphonomic groups, i.e. consumption refuse and bone-working refuse. Meat was mainly provided by domestic animals (ovicapripnes, cattle and pig), while wild animals, more specifically gazelles, did not represent a significant contribution to the diet of the inhabitants. Bone-working was almost exclusively restricted to camel bone. In addition, specific skeletal bones were selected. No finished bone objects were found at the site, but the bone waste points towards the presence of a specialised workshop during the Islamic period at Mar Nicola.

Keywords Mar Nicola, Palestine, Byzantine, Islamic, bone-working

Introduction

The site of Mar Nicola is located at the centre of Beit Jala, 2km to the northwest of Bethlehem (West Bank – Palestine), at a height of 825m above sea level (Fig. 30.1).

Mar Nicola is a church of Greek Orthodox denomination and was founded in the place of the old cave that was once inhabited by St Nicholas. A mosaic floor was discovered in 2002 during works that were carried out by the Beit Jala Municipality, in order to put a pipe canal in the street. Thereupon, a salvage excavation was conducted by the Department of Antiquities and Cultural Heritage under the supervision of Dr Hamdan Taha (General Director) and Mr Wael

Hamamreh. Two excavation areas were opened, i.e. area A, including the mosaic floor, and area B, to the south. The latter area was excavated in order to test the extent of the mosaic. Two phases were detected in area A, namely the Byzantine period and the Middle and Late Islamic period. Area B yielded remains that were possibly dated to the Roman period. This report deals with the faunal remains that were collected during the salvage excavation of Mar Nicola.

The faunal remains

The faunal remains were mainly collected by hand-picking in the excavation trench. Soil samples were taken from the floor surfaces and sieved using a 5mm mesh. The bulk of the animal remains were retrieved from area A, mostly from Islamic contexts. The other periods are rarely represented ([Table 30.1](#)).

The total assemblage is composed of 1195 specimens. The taxonomic composition of the animal remains is given in [Table 30.2](#). A total of 710 specimens (59.4% of the faunal assemblage), including the human bone, could be identified to species level. From [Table 30.2](#), it is clear that the majority of the animal remains are from mammals (both domestic and wild). Birds are represented by four bones only. In addition, there is one fragment of mother-of-pearl and one human bone. Most of the identifiable mammal remains are from domestic animals (99.6%); wild mammals are represented by three gazelle bones only. The unidentified animal remains (40.6% of the total assemblage) were sorted out according to the size of the animal they originated from, i.e. large and medium mammals.

Table 30.1. The total number of bone fragments (N) from Mar-Nicola, arranged by period. Bones from the same individual are counted as one.

<i>Period</i>	<i>Area B</i>	<i>Area A</i>		<i>Total</i>
	<i>Roman ?</i>	<i>Byzantine</i>	<i>Mid–Late Islamic</i>	
N	12	27	1156	1195

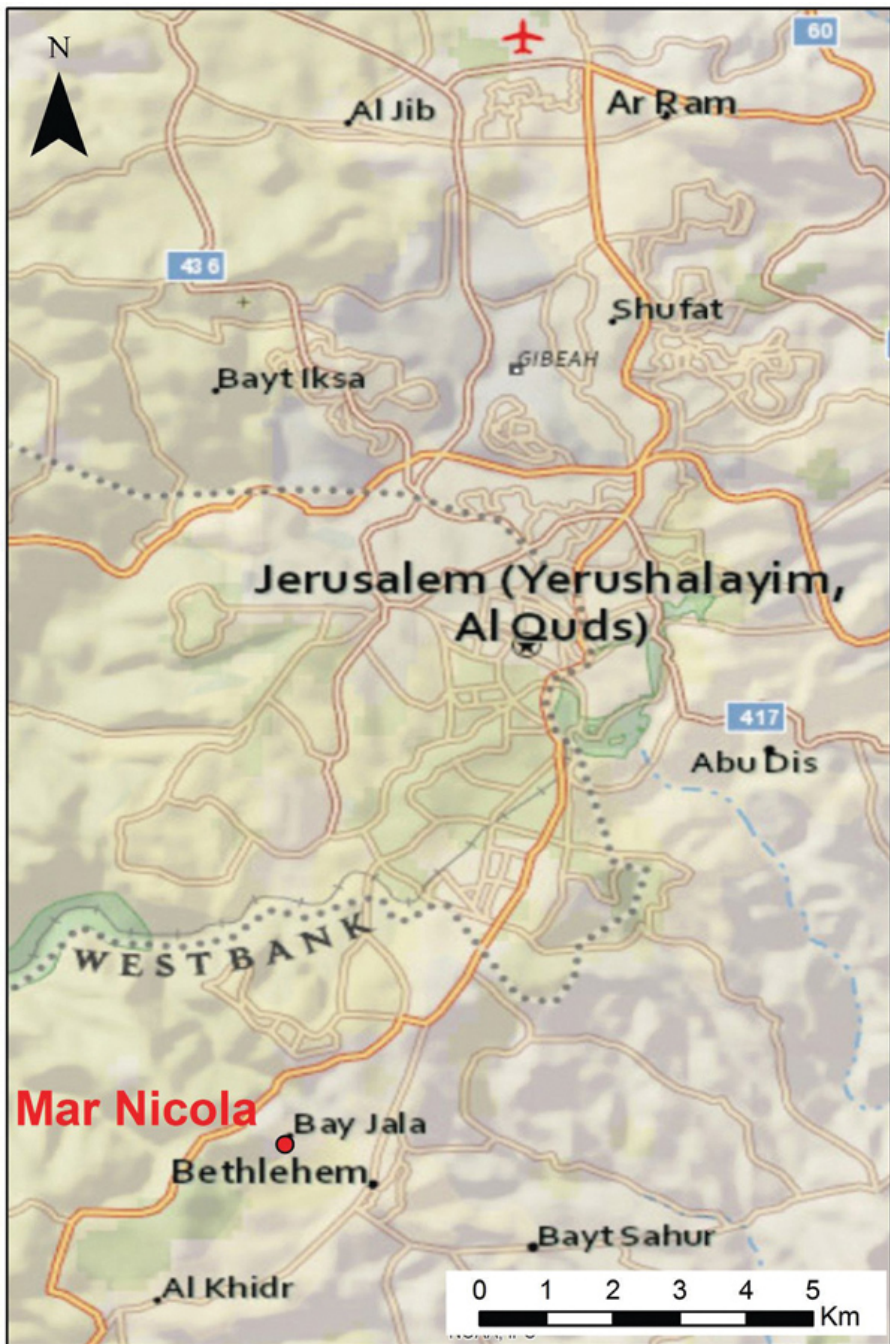


Figure 30.1. Location of Mar Nicola (Basemap source: National Geographic/Esri).

Domestic mammals

A total of 704 specimens are from domestic animals. Ovicaprids are

the best represented (58.4%), followed by cattle (24.7%) and dromedary (8.8%) (Table 30.2).

SHEEP (OVIS AMMON F. ARIES) AND GOAT (CAPRA AEGAGRUS F. HIRCUS)

More than half of the domestic identifiable remains originate from sheep and goats (58.4%). Due to their fragmentary state and the difficulty of separating the bones of sheep and goat (Boessneck 1969; Prummel & Frisch 1986), part of their remains had to be classified as ovicaprid (O/C). Not all the skeletal elements of the ovicaprids are evenly represented. Mandible fragments, humerus, radius and tibia are the most abundant, while the other elements are present but to a much lesser degree. The fragmentation rate of the sheep and goat bones was very high as a result of various activities, from both natural and anthropogenic origin. Indeed, many ovicaprid bones show traces of butchery activities, including both cut and chop marks (see Fig. 30.2 and Appendix). In addition, one proximal ulna fragment of ovicaprid has a saw mark.

Table 30.2. The number of animal remains from the site of Mar-Nicola, Beit Jala, throughout the various periods.

	Roman ?		Byzantine		Islamic		Total	
	N	%	N	%	N	%	N	%
<i>Molluscs</i>								
Mother of pearl	0	0	0	0	1	0.1	1	0.1
<i>Wild mammals</i>								
Gazelle (<i>Gazella gazella</i>)	0	0	1	0.1	2	0.1	3	0.3
<i>Domestic bird</i>								
Chicken (<i>Gallus gallus</i> f. <i>domestica</i>)	0	0	0	0	3	0.3	3	0.3
<i>Domestic mammals</i>								
Dromedary (<i>Camelus ferus</i> f. <i>dromedarius</i>)	0	0	0	0	62	5.2	62	5.2
Donkey (<i>Equus africanus</i> f. <i>asinus</i>)	8	0.7	1	0.1	11	0.9	20	1.7
Horse (<i>Equus ferus</i> f. <i>caballus</i>)	0	0	0	0	2	0.1	2	0.1
Pig (<i>Sus scrofa</i> f. <i>domestica</i>)	0	0	2	0.1	30	2.5	32	2.7
Goat (<i>Capra aegagrus</i> f. <i>hircus</i>)	0	0	3	0.3	51	4.3	54	4.5
Sheep (<i>Ovis ammon</i> f. <i>aries</i>)	0	0	1	0.1	30	2.5	31	2.6
Sheep/Goat	5	0.4	5	0.4	316	26.4	326	27.3
Cattle (<i>Bos primigenius</i> f. <i>taurus</i>)	0	0	5	0.4	168	14.4	173	14.5
Zebu (<i>Bos namadicus</i> f. <i>indicus</i>)	0	0	1	0.1	0	0	1	0.1
<i>Total domestic</i>	13	1.1	18	1.5	673	56.3	704	58.9
<i>Other</i>								
Human	0	0	0	0	1	0.1	1	0.1
<i>Unidentified</i>								
Bird	0	0	0	0	1	0.1	1	0.1
Large-sized mammals	0	0	6	0.5	211	17.7	217	18.2
Medium-sized mammals	5	0.4	0	0	216	18.1	221	18.5
Indeterminates	1	0.1	2	0.1	44	6.7	47	3.9
<i>Total unidentified</i>	6	0.5	8	0.7	471	39.4	485	40.6
<i>Total</i>	19	1.6	27	2.3	1149	96.2	1195	100



Fig. 30.2. Examples of cattle, sheep and goat bones with butchery marks.

Table 30.3. The age distribution of sheep and goats throughout the various phases of Mar Nicola; F: Fused; U: Unfused, N: number of specimens.

Age	Elements	Byzantine			Islamic			Total
		% U	% F	N	% U	% F	N	N
<1 y	scapula, acetabulum, dist. hum., prox. rad.	—	—	—	3.8	96.2	53	53
1–2 y	prox. ph 1,2, dist. mp, dist tib.	0.0	100.0	1	26.5	73.5	49	50
2–3 y	prox. ulna, prox. fem, calc., dist. rad.	—	—	—	57.9	42.1	19	19
3–4 y	prox. hum., dist. fem., prox. tib.	—	—	—	0	100	5	5

Age at slaughter of the ovicaprids has not been established using the eruption and wear of the mandibular teeth (Grant 1982) since no sufficient data were available. Instead the fusion rates of the different skeletal elements (Silver 1969) have been recorded; the results are presented in [Table 30.3](#).

Almost all of the data are from Islamic contexts. Although difficult to interpret, it can be concluded from these data that a small part of the sheep and goats died at a very young age. Considering the age and the absence of any kind of butchering mark on the juvenile remains, these individuals may have died a natural death (Payne 1973). A large part of the ovicaprid remains seem to have been slaughtered at a rather young age. Indeed, more than half of the articulations that close at an age of 2–3 years are still unfused. But, at the same time, about 75% of the articulations that close at an age of 1–2 years are

already fused. Another large group reached full maturity, i.e. older than 3 years. These data show that most probably during the Islamic period, after a minor culling of young animals at an age of about 1 year, a selection was made around the age of 2 years and some of the animals were slaughtered for meat. The remaining animals were kept to maintain the herd, and for the production of milk, wool, hair, etc.

CATTLE (BOS PRIMIGENIUS F. TAURUS)

A total of 174 fragments could be identified as cattle; one specimen, a thoracic vertebra, has (tentatively?) been identified as belonging to humped cattle or zebu ([Table 30.2](#)). Most of the cattle bones ($n=168$) were recovered from the Islamic contexts from area A, while only six fragments, including the zebu specimen, were dated to the Byzantine period. Cranial fragments (skull, mandible and teeth) dominate the sample, followed by the limb bones. Similar to the ovicaprid remains, the cattle remains were highly fragmented and many specimens had butchery marks. A total of 24 bones had cut marks and 37 had chop marks ([Fig. 30.2](#)). No complete cattle long-bones have been recovered, to enable the estimation of their shoulder heights. Again, since no sufficient data on mandibular teeth were available, ageing data have been obtained using the age of epiphyseal closure of the different skeletal elements. Almost all of the long-bones were fused and indicate that most of the cattle were killed at an adult age. This indicates the herding of cattle for their 'secondary' products, e.g. milk and traction. When they could no longer be used, they were slaughtered for consumption.

One bifid spinous process of the thoracic vertebra was found from area A in a Byzantine context. Bifid spines are one of the osteological criteria that has been used to identify zebu, but this character can sometimes also be found in cattle (Stallibrass 1983). In Palestine, zebu or humped cattle remains were identified in Gerar, dated to the 6th century BC (Clason 1978). Zeuner (1963) assumes that the introduction of humped cattle into Palestine was due to Persian influence. Remains of zebu cattle were found from many other sites, e.g. Tell Jenin/Late Bronze Age (Al-Zawahra, 1999), Kherbet Belameh (Al-Zawahra, 2002), Tell Jemmeh/Hellenistic granary, 300–200 BC (Wapnish 1982) and Tell Dan/mid-9th century BC (Wapnish & Hesse 1991). All this archaeological evidence points towards the exploitation of zebu, which has adapted to very warm temperatures in Palestine since the late 2nd millennium BC onwards.

PIG (SUS SCROFA F. DOMESTICA)

Pig remains are quite uncommon in the faunal assemblage of Mar

Nicola. This animal is represented by 32 bone fragments, mostly found in Area A (Table 30.2). The majority of the pig remains were recovered from Islamic contexts, only two fragments were dated to the Byzantine period. Five bones show chop marks, two fragments have cut marks, while a gnawing mark has been observed on one bone fragment. Except for two distal metacarpals, all of the long bones are fused. This indicates that these animals were mostly slaughtered when mature. In addition, there is a complete absence of foetal bones and the remains of immature and young individuals. The preponderance of mature pigs could well have to do with commerce strategies. Considering the fact that young pigs produce meat of a better quality, it is possible that these were sold and that only the meat of the older animals, e.g. sows that were no longer suitable for breeding, and thus also of lesser quality, was consumed at the site.



Fig. 30.3. General view of worked bone specimens from Mar Nicola.



Fig. 30.4. Camel metapodial waste remains from Mar Nicola with manufacturing traces.

DROMEDARY (CAMELUS FERUS F. DROMEDARIUS)

In total, 62 camel bones were found at the site of Mar Nicola ([Table 30.2](#)). All of them were collected in area A and dated to the Islamic period. Considering the fact that the site falls within the geographical distribution of *Camelus dromedarius*, all bones were assigned to this species. The camel bones consist almost exclusively of the long bones

of the lower part of the fore and hind limbs, i.e. radius, tibia, metacarpal and metatarsal. In addition, only the articular ends of these long bones are represented. With the exception of one mandible fragment, no other cranial or post-cranial elements of camel have been identified. Further, most of the camel remains ($n=48$) showed sawing traces and traces of working (Figs. 30.3–30.5 and Appendix). The worked bone fragments were included among others bone slices that had been bilaterally engraved in order to produce round cylindrical objects, with a diameter of about 5–7mm. This may correspond to the manufacturing of rosary beads or can be connected with the use of bone *tesserae* in mosaics. Polished bone has indeed a unique colour and shine that is not found in *tesserae* made of stone. However, the use of bone in mosaics still has to be investigated. It has been reported that bone is often used for the manufacturing of rosary beads (Alice Choyke, pers. comm. 2008) (Figs. 30.6 & 30.7).



Fig. 30.5. Different type of camel bones, with manufacturing marks.



Fig. 30.6. Bones sawed into slices and into small round cylindrical objects for the preparation of rosary beads.



Fig. 30.7. The manufacturing of rosary beads (photos are kindly provided by Prof. Alice Choyke).



Fig. 30.8. a. Articulated donkey foot indicating the presence of carcasses at Mar Nicola; b. donkey distal metapodial with saw mark.

So far, no butchery traces have been observed on the camel bones and, with the exception of one distal metapodial and one humerus, all bones are from adult individuals. In addition, it is clear from the skeletal distribution that only straight bones with a relatively thick shaft are ideal for bone-working.

This indicates that the camel bones may have been brought to the site of Mar Nicola exclusively for manufacturing activities.

EQUIDS

Among the equid remains from Mar Nicola, donkey (*Equus africanus* f. *asinus*) is much more common than horse (*Equus ferus* f. *caballus*). Both species are represented by respectively 20 and two bone specimens (Table 30.2). The cranial remains of donkey and horse were separated using the enamel patterns of the mandibular teeth (Clutton-Brock

1989).

The excavation at area B yielded in one context a metatarsal with articulating phalanges of donkey. This context was probably dated to the Roman period. More bones of donkey (n=11) were collected from area A and dated to the Islamic period; only one specimen is dated to the Byzantine period. No butchery evidence could be detected from these bones, but one donkey distal metapodial bone had been sawn (Fig. 30.8)

Horse is represented by one carpal bone and one third phalanx. Both of them were dated to the Islamic period.

CHICKEN (GALLUS GALLUS F. DOMESTICA)

Four bird fragments have been recovered at the site of Mar Nicola, three of them – a sternum, a pelvis and a femur – originate from domestic fowl. All four bird bones are dated to the Islamic period.

The chicken bones were checked for the presence of medullary bone but it could not be detected. The presence of medullary bone is restricted to female individuals during a specific time of the year, more precisely during the egg laying season (Lentacker & Van Neer 1996). The absence of medullary bone in the material of Mar Nicola indicates that the sample is composed of either male chickens or females which were killed before or after the egg laying season.

GAZELLE (GAZELLA GAZELLA)

Three bones were identified as gazelle. All three were collected from area A and included two fragments – a metatarsal and a 1st phalanx – that were dated to the Islamic period; one metacarpal bone was found from a Byzantine context. The latter specimen has a cut mark. According to the zoogeographical distribution of gazelle (Tchernov *et al.* 1986/7), these gazelle bones could be attributed to the mountain gazelle, *Gazella gazella*.

SHELLS

Only one shell was found at the site of Mar Nicola. It is a fragment of mother-of-pearl and was retrieved from area A in an Islamic context. The shell is sawn at both sides. This points towards the use of mother of pearl as a raw material for the manufacturing of objects.

THE UNIDENTIFIED BONES

A total of 485 bone fragments, 40.6% of the whole assemblage, could not be identified to taxon. But, they were sorted according to animal size. About half of them could be classified as medium-sized mammals, while the other half originated from large-sized mammals

(Table 30.2). The relatively high proportion of unidentified bones is a result of the high degree of fragmentation. Many of these unidentified fragments have also cut (n=18), chopping (n=15) and sawing (n=10) marks (cf. Appendix).

Taphonomy

The preservation state of the animal bones is very good. However, they are quite fragmented and show many anthropogenic modifications (cf. Appendix). As already mentioned above, many specimens show butchery and manufacturing traces: 18.6% of the bone fragments show evidence of butchery (Fig. 30.2), while 5.2% show working traces, mostly saw marks, resulting from manufacturing activities (Figs. 30.3–30.5, 30.8). Few specimens (1%) show traces of carnivore damage.

The majority of the animal remains can be considered as consumption refuse. All of the butchery marks that are represented on the sheep/goat bones are the result of dismembering the animals and chopping these parts into smaller pieces. Cattle bones, on the other hand, show also traces of skinning and defleshing. In addition, chop marks on vertebrae show that the vertebral column was divided in a bilateral direction. It can be deduced, from the width and the depth of the marks, that strong and large axes were used for butchery activities.

A second taphonomic group consists of the waste of artisan activities. The sawing marks on the camel bones and on a few other species, indicates that bone was used for the manufacturing of objects at the site of Mar Nicola. It is possible that a specialised workshop for the production of rosary beads was located here. However, no finished objects have been found, only unfinished objects and waste fragments related to bone working were collected. Motherofpearl was used as a raw material at the site.

The faunal assemblage of Mar Nicola also contained the remains of carcasses, or animals that were not eaten. The equid remains belong to this third taphonomic group, as for example indicated by the articulated bones of donkey in area B. It is possible that bones from donkey and camel carcasses were collected for manufacturing activities. Probably, the latter may have been deposited elsewhere, as only a limited number of skeletal elements were represented at the site.

Summary and conclusion

The site of Mar Nicola is located in the centre of Beit Jala, 2km northwest of Bethlehem, Palestine. The animal bone assemblage from this site consists of three taphonomic groups, i.e. 1) refuse from food consumption, 2) waste of artisanal activities, and 3) carcasses (Gautier 1987). Meat was primarily provided by domestic mammals (ovicaprids, pigs and cattle), while wild animals, more specifically gazelle, did not represent a significant contribution to the diet of the inhabitants. Sheep and goat remains are the most abundant among the domestic animals, followed by cattle. No signs of butchery could be found on the equid remains, suggesting that they were not consumed but that they were only used for transport. The waste of artisanal activities predominantly included camel bones. These comprised the proximal and distal ends of the long straight limb bones, and almost all of them exhibited saw traces. Other animals with traces of sawing included sheep/goat, donkey and mollusc. Due to the presence of a Byzantine church, bone and mother of pearl may have been brought to the site as a raw material for manufacturing religious objects such as rosary beads and necklaces, or decoration objects, such as *tesserae* for mosaics. No finished objects were found within the bone assemblage, only unfinished object fragments and related waste were discovered. This shows that the site of Mar Nicola was a specialised centre for the production of handicrafts and religious items during the Islamic period.

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Appendix: inventory of all traces observed on the faunal remains of Mar Nicola (Beit Jala)

(LM: large sized mammal; MM: medium-sized mammal; R: right; L: left; A: axial; PF: proximal fused; DF: distal fused; DFG: distal fusing; AF: acetabulum fused; C: cut mark; CH: chop; B: burnt; G: gnaw; P; pathology; PO: polish; S: saw marks)

Cont.	Num	Elem	Species	Frag	S	%	Fus	C	Ch	B	G	P	PO	S	Remarks
A.1.1.58	468	Astr	Bos	Comp	R	100		C							On art. facet/ head
A.2.1.27	338	Astr	Bos	Incomp	R	75		C							Vent. mid.
A.3.1.43	637	Astr	Bos	Incomp	L	75		C							Cs at med. mid.
A.1.1.10	76	Axis	Bos	Art.	A	25		C							Long. Cut on wing
A.1.1.17	50	Axis	Bos	Frag	A	50		C							Mid. lat.
A.3.1.43	659	Carp	Bos	Comp		100		C							Many parallel, ant. art. facet
A.1.1.56	291	Cran	Bos	Temp	L	<25		C							Condyle joint
A.2.1.27	336	Cran	Bos	Pmax	L	<25		C							C. many dorsal
A.1.1.5	587	Hum	Bos	Dist	L	25	DF	C	CH						C med./ch. med.
A.1.1.58	477	Hum	Bos	Dia		<25		C							Many on lat.
A.3.1.63	462	Hum	Bos	Dist	R	<25	DF		CH						Med.obl.
A.1.1.10	69	Mand	Bos	Ramus	R	<25		C							Lat. wide at caronoid
A.1.1.13	164	Mand	Bos	Ramus	L	<25			CH						Post. mid. ramus
A.1.1.13	171	Mand	Bos	Ramus	L	<25			CH						Post. ramus 3 wide marks
A.1.1.56	303	Mand	Bos	Condyl	R	<25			CH						Ext. close art. facet
A.1.1.58	478	Mand	Bos	Ramus	R	<25			CH						Lat. & between processes
A.3.1.63	444	Mand	Bos	Ramus	L	<25			CH						Lat. med.
A.1.1.10	125	Mc	Bos	Prox	L	<25	PF	C							Many dors.
A.1.1.3	703	Mc	Bos	Prox	R	<25	PF		CH						Mid. med. & lat.
A.2.1.27	332	Mc	Bos	Prox	R	75	PF		CH						
A.3.1.43	639	Mc	Bos	Prox	R	25	PF	C							Med./ant. close art. facet
A.1.1.13	163	Mp	Bos	Dist	R	<25	DF	C							Ant. on articular facet
A.3.1.43	674	Mp	Bos	Dia		<25		C							
A.1.1.10	68	Mt	Bos	Prox	R	25	PF	C							Close to art. facet
A.1.1.56	310	Mt	Bos	Prox	L	50	PF	C							Close art. facet
A.1.1.56	309	Mt	Bos	Prox	R	50	PF		CH						Mid. shaft
A.1.1.58	474	Mt	Bos	Prox	L	25	PF		CH						Close to art. facet, med.
A.3.1.43	633	Mt	Bos	Prox	L	25	PF	C	CH						CH. at med. C. close art. facet
A.3.1.43	634	Mt	Bos	Prox	R	50	PF		CH						Mid. lat.
A.1.1.13	168	Pelv	Bos	Ilium		<25		C							
A.1.1.13	165	Pelv	Bos	Ilium	R	<25		C	G						C base ilium
A.1.1.3	704	Pelv	Bos	Pubis		<25	AF		CH						On art. facet & body
A.1.1.5	600	Pelv	Bos	Pubis		<25	AF	C							
A.1.1.10	107	Phl	Bos	Comp	R	100	PFDf	C							Lat.
A.1.1.13	177	Phl	Bos	Incomp	L	75	PFDf	C	CH						C. ant./CH. lat.
A.1.1.13	178	Phl	Bos	Comp	L	100	PFDf	C							C. lat. on art. facet
A.1.1.17	9	Phl	Bos	Comp	R	100	PFDf	C							On art. facet
A.3.1.43	636	Phl	Bos	Comp	R	100	PFDf	C							Ant. mid.
A.3.1.43	640	Phl	Bos	Comp	R	100	PFDf	C							Ant. close on art. facet
A.3.1.63	441	Phl	Bos	Comp	R	100	PFDf	C							Dors. prox. facet
A.1.1.58	509	Pmax	Bos	Incomp	L	<25		C							C. on pmax. caud.
A.1.1.13	158	Rad	Bos	Prox	L	<25	PF	C							Ant. med. close to art. facet
A.1.1.17	3	Rad	Bos	Prox	L	<25	PF	C							Post.med.
A.1.1.56	311	Rad	Bos	Dia	L	<25			CH						
A.1.1.58	504	Rad	Bos	Dia	L	<25			CH						Lat. prox
A.2.1.27	339	Rad	Bos	Prox	L	25	PF	C	CH						C. med., CH. Ant.
A.3.1.63	464	Rad	Bos	Prox	R	<25	PF		CH						Ant. 1cm from art. facet
A.1.1.13	185	Scap	Bos	Dist	R	<25	DF		CH						Ch. at neck
A.1.1.17	55	Scap	Bos	Dist		<25		C							Close to art. facet
A.1.1.13	159	Tarsal	Bos	Incomp	R	75			CH						Many lat.
A.2.1.27	337	Tarsal	Bos	Comp	L	100		C							At both sides/navic.
A.1.1.58	470	Tib	Bos	Dist	L	<25	DF		CH						Lat. 8cm of dist. end
A.1.5.32	263	Tib	Bos	Dist	L	<25	DF	C							Lat.
A.3.1.63	443	Tib	Bos	Dist		<25	DF	C	CH						Med. art. facet
A.1.1.10	75	Ulna	Bos	Prox	R	25	PF	C							
A.1.1.17	52	Ulna	Bos	Prox	L	<25	PN		CH						Dors.
A.2.1.27	321	Hum	Camel	Prox		<25	PN	C							On art. facet
A.1.1.13	190	Mc	Camel	Prox	L	<25	PF							S	
A.1.1.16	752	Mc	Camel	Prox		<25	PF							S	
A.1.1.5	589	Mc	Camel	Prox	R	<25	PF							S	
A.1.1.51	773	Mc	Camel	Prox	L	<25	PF							S	Working piece
A.2.1.27	318	Mc	Camel	Prox	L	<25	PF	C						S	C. ant. art. facet

Cont.	Num	Elem	Species	Frag	S	%	Fus	C	Ch	B	G	P	Po	S	Remarks
A.2.1.27	319	Mc	Camel	Prox	L	<25	PF							S	
A.2.1.35	618	Mc	Camel	Prox	L	<25	PF	C						S	C. on art. facet
A.3.1.43	635	Mc	Camel	Prox	R	<25	PF		CH					S	Lat. close art. facet
A.1.1.10	65	Mp	Camel	Dist	R	<25	DF							S	3cm an art. facet
A.1.1.10	66	Mp	Camel	Dist	R	<25	DF			G				S	4cm an art. facet
A.1.1.12	748	Mp	Camel	Dia		<25								S	M: 35
A.1.1.13	191	Mp	Camel	Dist		<25	DF							S	
A.1.1.13	192	Mp	Camel	Dia		<25								S	Sawed bilaterally
A.1.1.13	193	Mp	Camel	Dia		<25								S	
A.1.1.17	48	Mp	Camel	Dist	L	<25	DF							S	
A.1.1.17	47	Mp	Camel	Dist	R	<25	DF							S	
A.1.1.5	553	Mp	Camel	Dist	L	<25	DF							S	
A.1.1.5	555	Mp	Camel	Dist	L	<25	DF							S	
A.1.1.5	552	Mp	Camel	Dist	R	<25	DF	C						S	C. At articular facet, lat.
A.1.1.5	556	Mp	Camel	Dist	R	<25	DF							S	
A.2.1.27	313	Mp	Camel	Dia		<25								S	Sawed piece
A.2.1.27	320	Mp	Camel	Dia		<25								S	Working piece
A.2.1.68	736	Mp	Camel	Dia		<25								S	Working piece
A.3.1.43	642	Mp	Camel	Dist		<25	DF							S	
A.3.1.63	445	Mp	Camel	Dist	R	<25	DF							S	Swaed
A.1.1.10	64	Mt	Camel	Prox	R	<25	PF	C						S	2cm an art. facet, c.med.
A.1.1.10	63	Mt	Camel	Prox	R	<25	PF							S	Sawed 1cm an art. facet
A.1.1.13	188	Mt	Camel	Prox	R	<25	PF	C						S	
A.1.1.13	189	Mt	Camel	Prox	R	<25	PF							S	
A.1.1.5	590	Mt	Camel	Prox	R	<25	PF							S	
A.1.1.51	772	Mt	Camel	Prox	R	<25	PF							S	Working piece
A.2.1.27	316	Mt	Camel	Prox	R	<25	PF	C				P		S	C. ant. med.
A.2.1.27	317	Mt	Camel	Prox	R	<25	PF							S	
A.2.1.68	738	Mt	Camel	Prox	L	<25	PF							S	
A.2.1.27	335	Ph1	Camel	Incomp		75	PFDF		CH					S	Long. chopping
A.1.1.17	2	Rad	Camel	Dia	L	<25		C	CH					S	Cs lat/ant. CH. Lat
A.1.1.17	1	Rad	Camel	Dia	R	<25								S	Working piece sawed bi
A.1.1.4	745	Rad	Camel	Dia		<25								S	
A.1.1.5	609	Rad	Camel	Dia										S	Working piece
A.1.1.5	610	Rad	Camel	Dia										S	
A.1.1.51	771	Rad	Camel	Dia		<25								S	Working piece
A.2.1.27	315	Rad	Camel	Prox	L	<25	PF							S	
A.2.1.27	326	Rad	Camel	Dia	L	<25								S	
A.2.1.27	314	Rad	Camel	Dist	R	<25	DF		CH					S	Med. caud. On art. facet
A.2.1.27	325	Rad	Camel	Dist	R	<25	DF							S	
A.2.1.35	619	Rad	Camel	Prox	L	<25	PF							S	
A.2.1.68	737	Rad	Camel	Dia		<25								S	Working piece
A.3.1.63	457	Rad	Camel			<25							PO	S	
A.2.1.68	740	Tarsal	Camel	Comp		100		C						S	
A.1.1.5	551	Tib	Camel	Dist	R	<25	DFG							S	
A.1.1.58	467	Tib	Camel	Dist	R	<25	DF							S	Sawed
A.1.1.10	132	Calc	Capra	Comp	L	100	PN	C						S	Below dist. art. facet
A.1.1.13	235	Cornu	Capra	Frag	L	50			CH					S	Mid.
A.2.1.27	394	Cornu	Capra	Incomp	L	50			CH					S	At base
A.1.1.13	236	Cran	Capra	Occ.	A	25			CH					S	Right below horn base
A.1.1.10	89	Hum	Capra	Dist	R	<25	DF	C						S	Med. lat. close trochlea
A.3.1.43	651	Hum	Capra	Dia	L	50	DF	C	CH					S	On art. facet/mid. med.
A.3.1.43	653	Hum	Capra	Dist	R	<25	DF	C	CH					S	On art. facet & neck
A.1.5.32	261	Mt	Capra	Prox	R	<25	PF	C						S	Med. close art. facet
A.1.1.13	218	Ph2	Capra	Comp	L	100	PFDF	C						S	C. ant. close art. facet
A.1.1.5	595	Rad	Capra	Prox	R	50	PF	C	CH					S	Lat. on art. facet
A.2.1.27	350	Rad	Capra	Prox	L	25	PF	C						S	Post. close art. facet
A.2.1.27	347	Rad	Capra	Prox	R	25	PF	C						S	Ant. med. close art. facet
A.1.1.17	17	Scap	Capra	Dist	L	25	DF	C	CH					S	C. med. on art. facet
A.1.5.32	275	Scap	Capra	Dist	L	<25	DF	C	CH					S	C. art. facet & CH. lat. At neck
A.3.1.43	672	Scap	Capra	Dist		<25	DF		CH					S	Med. lat.
A.2.1.27	331	Mp	Donkey	Dist	L	<25	DF							S	Sawed with technique
A.1.5.32	268	Mc	Gazcel	Prox	R	75	PF	C						S	Med.
A.1.1.58	481	Fem	Indet	Dist		<25	DF		CHI		G			S	On condyle
A.3.1.63	453	Indet	Indet										PO	S	Swaed
A.3.1.63	454	Indet	Indet										PO	S	
A.3.1.63	456	Indet	Indet										PO	S	
A.3.1.63	459	Indet	Indet										PO	S	Bead core
A.3.1.63	460	Indet	Indet										PO	S	
A.3.1.63	461	Indet	Indet										PO	S	
A.3.1.63	463	Indet	Indet										PO	S	

Cont.	Num	Elem	Species	Frug	S	%	Fus	C	Ch	B	G	P	Po	S	Remarks
A.1.1.10		Lm	Indet	7					CH						1 with chopping mark
A.1.1.5	615	Tool	Indet											S	
A.1.1.51	760	Tool	Indet											S	Working piece
A.1.1.58		Costa	Lm	3					CH						1 with chopping mark
A.3.1.63		Costa	Lm	3					CH				P		2 CH/1 path.
A.1.1.17	5	Fem	Lm	Dist		R	<25		CH						Wide mark
A.3.1.43	641	Hum	Lm	Dia			<25		CH						
A.1.1.13		Indet	Lm	18				C							Two with Cs
A.1.1.3		Indet	Lm	4										S	All sawed
A.1.1.5	573	Indet	Lm						CH						Many parallel marks
A.1.1.5	611	Indet	Lm	Dia										S	
A.1.1.58		Indet	Lm	8				C							2 with cut
A.2.1.68	742	Indet	Lm											S	Working piece
A.3.1.43	649	Indet	Lm	Dia			<25						PO	S	
A.1.1.13	247	Mand	Lm	Ramus			<25		CH						
A.1.1.17	11	Mp	Lm	Dia			<25		CH						Uniside sawed
A.1.1.10	131	Tool	Lm	Dia										S	Sawed
A.1.1.5	612	Tool	Lm	Dia										S	
A.1.1.5	613	Tool	Lm	Dia										S	
A.1.1.5	614	Tool	Lm	Dia										S	
A.1.1.58	549	Tool	Lm				<25		CH						A chesil frag
A.1.1.58	550	Tool	Lm						CH						
A.1.1.13		Vert	Lm	6				C							One with C
A.1.1.17		Vert	Lm	6				C							Three with C marks
A.3.1.63		Vert	Lm	4					CH						1 CH.
A.1.1.58		Costa	Mm	4					C						1 with cut
A.1.1.13		Indet	Mm	21					C						Three with cut
A.1.1.58		Seap	Mm				<25		CH						
A.1.1.13		Vert	Mm	7				C							Two with C
A.1.1.17		Vert	Mm	5				C							One with C
A.1.1.4		Vert	Mm	Frag		A	<25		C						C, on arch
A.3.1.63		Vert	Mm	3					CH						1 a./1 ch.
A.1.1.56	292	Atlas	O/c	Frag		A	50		C						Ant. at wings
A.1.1.17	51	Axis	O/c			A	50		C						Long. C.
A.2.1.27	388	Axis	O/c	Frag		A	50		C						Dors.
A.3.1.63	451	Cran	O/c	Frontal		L	<25		CH						Horn base, to remove it
A.1.1.10	133	Fem	O/c	Dist		R	<25	DF	C						
A.1.1.10	81	Fem	O/c	Dist		R	<25	DF	CH						Dors. on art. facet
A.3.1.63	412	Fem	O/c	Dia		L	<25	DF	CH					S	
A.1.1.10	90	Ilium	O/c	Dia		L	<25		CH						Mid.
A.1.1.13	224	Hum	O/c	Dist		L	<25	DF	C						Lat. on art. facet
A.1.1.13	234	Hum	O/c	Dist		L	<25	DF	C						Ant. close to troch.
A.1.1.13	227	Hum	O/c	Dist		L	25	DF	CH						Mid. med.
A.1.1.13	233	Hum	O/c	Dist		R	<25	DF	C						On trochlea
A.1.1.13	225	Hum	O/c	Dia		R	25		CH						Mid.
A.1.1.13	229	Hum	O/c	Dia		R	50		CH						Many parallel med.
A.1.1.17	35	Hum	O/c	Dia		R	<25		C						
A.1.1.17	30	Hum	O/c	Dia		R	<25		C						Cs deep dors.
A.1.1.5	569	Ilium	O/c	Dist		L	25	DF	C	CH					C, ant./lat & CH. med./dist
A.1.1.5	568	Ilium	O/c	Dist		L	<25	DF	C						Lat. dors.
A.1.1.5	597	Hum	O/c	Dist		L	<25	DF	C						Med.
A.1.1.58	486	Hum	O/c	Dia		R	25		CH						
A.2.1.27	384	Hum	O/c	Dist		L	25	DN	CH						Med. mid. of shaft
A.3.1.43	655	Hum	O/c	Dia		L	<25		CH						Mid.
A.3.1.43	656	Hum	O/c	Prox		L	<25		CH						On prox. area dors.
A.3.1.43	654	Hum	O/c	Dia		L	<25		C						Mid. lat.
A.3.1.43	657	Hum	O/c	Dist		R	<25	DF	CH						Med. neck
A.3.1.63	411	Hum	O/c	Dist		R	<25	DF	CH						Lat. dor.
A.1.1.56	282	Mand	O/c	Trans		L	75		C						C ext.
A.3.1.43	689	Mand	O/c	Ramus		L	<25		C						Ext. on the neck
A.1.1.10	97	Me	O/c	Prox		L	25	PF	C						Lat. ant. close art. facet
A.1.1.10	115	Me	O/c	Prox		R	75	PF	C						Ant. med.
A.1.1.51	764	Mp	O/c	Dist		L	<25	DN	CH						Close to dist.
A.1.1.58	514	Mt	O/c	Dist		R	50	DF	CH						At lat. dist.
A.2.1.27	377	Mt	O/c	Prox		L	25	PF	C						Ant. med.
A.1.1.10	139	Pelv	O/c	Ilium		L	<25	AF	CH						3 parallel lat.
A.1.1.10	136	Pelv	O/c	Ilium		R	<25	AF	C						Dors. pre-tuberosity
A.1.1.13	250	Pelv	O/c	Acet		R	<25		CH						Base of ilium
A.1.1.17	53	Pelv	O/c	Ilium		R	<25		C						Med. ant. to acet.
A.1.1.17	57	Pelv	O/c	Ischium		R	<25	AF	C						Post. to acet

Con.	Num	Elem	Species	Frog	S	%	Fus	C	Ch	B	G	P	Ps	Remarks
A.1.1.58	523	Pelv	O/c	Ischium	L	<25	AN	C						Before lip
A.2.1.35	625	Pelv	O/c	Ischium	L	<25	AF	CH						
A.1.1.10	124	Rad	O/c	Dist	L	50	DF	C	CH					CH, dors. mid./C. on art. facet
A.1.1.10	91	Rad	O/c	Dist	L	50	DF	C						Lat. mid. artic. facet
A.1.1.10	92	Rad	O/c	Dia	R	25		C						Lat.
A.1.1.10	121	Rad	O/c	Dia	R	25		C						Ant.
A.1.1.10	122	Rad	O/c	Dist	R	<25	DF	C						Ant. many
A.1.1.13	214	Rad	O/c	Prox	L	25	PF	C						Med.
A.1.1.5	577	Rad	O/c	Dia	L	75		C						Ant./med.
A.1.1.58	497	Rad	O/c	Dia	R	50		C						Med.
A.1.1.58	496	Rad	O/c	Dia	R	50		CH						Mid./dist. med.
A.1.5.32	265	Rad	O/c	Prox	R	25	PF	CH						Med. mid.
A.2.1.27	380	Rad	O/c	Prox	R	25	PF	C						Dors. on art. facet
A.2.1.27	382	Rad	O/c	Dist	R	25	DN	C						Med.
A.2.1.27	348	Rad	O/c	Prox	R	25	PF	CH						Head, lat.
A.2.1.27	381	Rad	O/c	Dia	R	25		CH						
A.3.1.43	670	Rad	O/c	Prox	L	<25	PF	CH						Ant.
A.3.1.43	666	Rad	O/c	Dia	R	<25		CH						Med.
A.3.1.43	667	Rad	O/c	Dist	R	25	DF	CH						Mid both sides
A.3.1.63	448	Rad	O/c	Dia	R	25		CH						Mid all around
A.1.1.13	237	Scap	O/c	Blade	R	<25		CH						Neck
A.1.1.58	490	Scap	O/c	Dia	R	<25		CH						Base of spine
A.2.1.27	359	Scap	O/c	Dist	R	25		C						Close art. facet
A.2.1.27	362	Scap	O/c	Dist	R	<25	DF	C						Caud. on necke
A.3.1.63	414	Scap	O/c	Dist	L	<25	DN	C						Caud. neck
A.3.1.63	417	Scap	O/c	Dist	R	25		C						Caud. neck
A.3.1.63	415	Scap	O/c	Dist	R	25	DF	CH						Dors. neck
A.1.1.10	85	Tib	O/c	Dia	R	50		C						Cuts ant. post. distally
A.1.1.10	112	Tib	O/c	Dia	R	25		C						
A.1.1.10	113	Tib	O/c	Dia	R	25		CH						Many parallel, med.
A.1.1.13	253	Tib	O/c	Dia	R	50		CH						Med. prox.
A.1.1.13	255	Tib	O/c	Dia	R	<25		CH						Med.
A.1.1.13	256	Tib	O/c	Dist	R	25	DF	CH						Med. close to dist.
A.1.1.17	40	Tib	O/c	Dia	L	<25		C						Cuts med. mid.
A.1.1.17	37	Tib	O/c	Dist	L	50	DF	CH						Mid
A.1.1.17	39	Tib	O/c	Dia	R	25		C						Cuts mid. dors.
A.1.1.5	579	Tib	O/c	Dia	L	75		CH						Many parallel/ dors.
A.1.1.5	564	Tib	O/c	Dia	R	25		CH						Med. mid
A.1.1.58	501	Tib	O/c	Dist	L	25	DF	CH						Lat. med.
A.1.1.58	503	Tib	O/c	Dia	L	<25		CH						Med. mid
A.1.1.58	506	Tib	O/c	Dia	L	50		CH						Mid dors/med.
A.2.1.27	352	Tib	O/c	Dist	L	25	DN	C						Med.
A.2.1.27	399	Tib	O/c	Dist	L	<25	DF	CH						Ch. med.
A.2.1.27	392	Tib	O/c	Dia	R	25		CH						Lat.
A.2.1.35	623	Tib	O/c	Dist	R	25	DF	CH						Med. mid. of shaft
A.3.1.43	681	Tib	O/c	Dist	L	<25	DF	CH						
A.3.1.43	665	Tib	O/c	Dia	R	25		CH						Med.
A.3.1.63	458	Tib	O/c	Dia	R	<25		CH						Mid dors.
A.1.1.58	499	Ulna	O/c	Semih	R	<25		C						Dorsal
A.3.1.53	728	Astr	Ovis	Incomp	L	75		C						On head dist
A.1.1.10	88	Hum	Ovis	Dist	L	<25	DF	CH						Lat. at artic. facet
A.1.1.13	226	Hum	Ovis	Dist	L	<25		C						Med.
A.1.1.13	228	Hum	Ovis	Dist	L	<25		C						Med.
A.1.1.17	31	Hum	Ovis	Dist	L	<25	DF	C						Lat. dor.
A.3.1.43	652	Hum	Ovis	Dist	R	25	DF	CH						On art. facet
A.1.1.17	25	Me	Ovis	Prox	R	25	PF	C						Two parallel Cs
A.1.5.32	262	MP	Ovis	Dist	L	25	DF	CH						Lat. many
A.1.1.10	119	Rad	Ovis	Prox	L	25	PF	C						Med. on art. facet
A.1.1.13	211	Rad	Ovis	Prox	R	25	PF	C						On articular facet
A.1.1.13	212	Rad	Ovis	Prox	R	25	PF	CH						Dors. ulna join area
A.2.1.27	349	Rad	Ovis	Prox	L	<25	PF	CH						Post. med.
A.1.1.10	79	Scap	Ovis	Dist	L	<25	DF	CH						4 parallel at neck
A.1.1.13	222	Scap	Ovis	Dist	L	25	DN	C						Caud. close art. facet
A.2.1.27	360	Scap	Ovis	Dist	L	<25	DF	CH						Dors. half
A.1.1.17	18	Ulna	Ovis	Prox	R	<25	PN	CH						Dors. una arch
A.1.1.50	712	Shell	Shell	I				S						Sawn at both sides
A.1.1.17	44	Hum	Sus	Dist	R	<25	DF	C						Med. lat.
A.1.1.5	582	Hum	Sus	Dia	L	<25		CH						Ant.
A.1.5.32	266	Hum	Sus	Dia	L	<25		CH						Dors.
A.1.1.10	154	Pelv	Sus	Acet	L	<25	AF	CH						Dors. base of ischium
A.1.1.58	526	Pelv	Sus	Acet	L	25	AF	C	CH					Both at base ilium
A.1.1.5	560	Tib	Sus	Dist	R	<25	DF	CH		G				

31. Faunal analysis of the Castle of Aqaba (Jordan): preliminary results

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Excavations at the Castle of Aqaba have yielded a large amount of animal remains mainly dating to the Mamluk, Ottoman and Modern periods. The archaeozoological analysis of this assemblage provided an insight into the food provisioning of the site's inhabitants. The bulk of the animal food products were provided by sheep and goat, complemented by camel and with very few cattle. Hunting played only a minor role in the food economy, while fishing and harvesting shellfish must have been more important. The faunal data suggest diachronic changes in the herd management and fishing strategies.

Keywords archaeozoology, Jordan, Aqaba Castle, food provisioning, Mamluk period, Ottoman period, Modern period

Introduction

After environmental archaeology had slowly gained a place within the archaeological fieldwork in the Near East, and Jordan in particular, more efforts were spent on prehistoric sites. Only recently, later periods also came into the focus of attention, e.g., with the archaeozoological work at Petra (Nabatean to Late Roman, medieval; Studer 1994; 2002a; 2007; 2008; Schmidt & Studer 2003), Jebel an-Nabi Harûn (Byzantine; Studer 2001; 2002b), Deir 'Ain 'Abata (Byzantine; Beech 1992) and central Jordan (Roman; Toplyn 1994; 2006). The present study of the animal remains from the castle at Aqaba follows this trend and perhaps presents a new scope, by including for the first time Jordanian material from the post-medieval period, even the early 20th century. The aim of the analysis

introduced in the present report, is to understand at least a part of the site's economy, and especially the organisation of the food supply as far as meat is concerned. In a second step, a diachronic comparison between the consumption patterns of the different occupation phases of the site is undertaken.

The Castle of Aqaba

Aqaba is situated in southern Jordan on the coast of the Red Sea, more precisely at the northern end of the Gulf of Aqaba (Fig. 31.1). The region lies within the Syro-African Rift Valley that goes through the Gulf of Aqaba and the Wadi Araba up to the Dead Sea and the Jordan valley. The contemporary climate is arid, with a mean annual rainfall of 40mm; precipitation falls only in the winter months. Summers are characterised by high temperatures, which often exceed 40°C. At its continental side, Aqaba is surrounded by deserts, i.e. the Sinai (W), the Negev (N) and the Hisma (NE-E-S). The coastal plain is encircled by mountains but has access to the north by the Wadi Arabah, which is accessible through the Wadi al-Yutum to the northeast of Aqaba. Vegetation in the Wadi Arabah is controlled by the soil moisture, which is conditioned by topographical factors and the ground-water level, located just below the surface in the southern part of the valley. The extreme aridity of the region results in the lack of a permanent watercourse in the wadi (Zohary 1945; Niemi, cited in Parker 1996).

Excavations have been carried out at several locations within the present city of Aqaba. The three historical sites include the Nabatean/Roman/Byzantine Aila (under the direction of S. T. Parker, North Carolina State University), the Early Islamic/medieval Ayla (under the direction of D. Whitcomb, Oriental Institute Chicago) and the medieval to recent times castle (Fig. 31.2). The excavations of the castle have been carried out within the framework of the 'Aqaba Castle Project' (2000–2003 under the direction of J. Demeulemeester, Ministère de la Région wallonne (Belgium), and D. Pringle, Cardiff University (UK); 2005–2008 under the direction of J. Demeulemeester and R. al-Shqour, both Ghent University (Belgium)). Additionally, the 'Islamic Aqaba Project' was set up, which constitutes a research programme that aims to link the former American excavations of the medieval town of Ayla (1986–1993) and the excavations of the castle. So far, only preliminary reports are available for the castle excavations (De Meulemeester & Pringle 2001; 2002; 2004; 2005; De Meulemeester & al-Shqour 2006). Moreover, the most recent data on the chronology and development of the site provide new, albeit again preliminary, insights (al-Shqour *et al.* 2008). The chronological

framework for the site used in the present report must thus be regarded as a first approach, without doubt to be refined by future research.

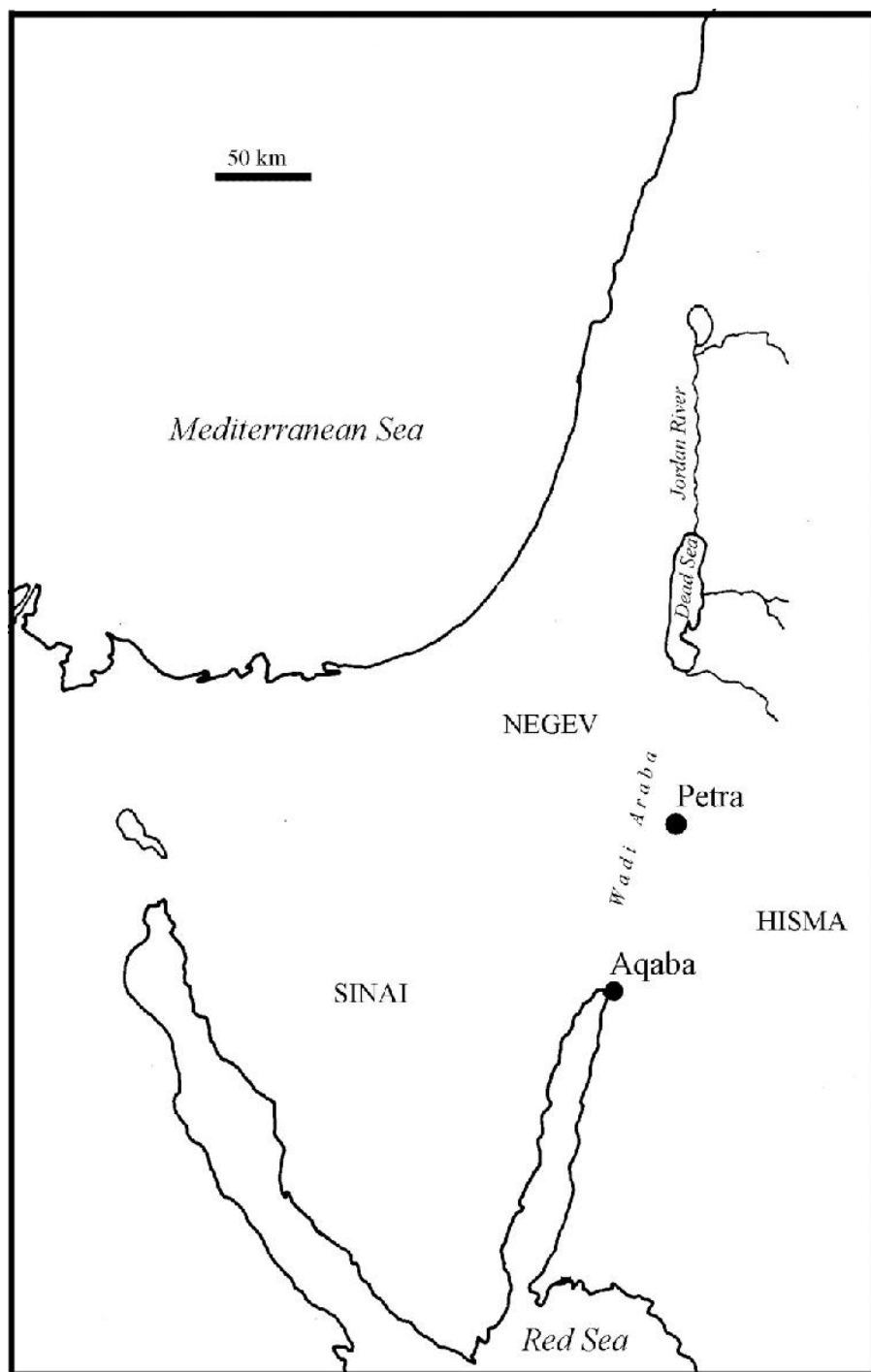


Fig. 31.1. Location of Aqaba.



Fig. 31.2. Aerial view of the Castle of Aqaba (from Kennedy & Brewley 2004).

The castle is commonly believed to have been built in the 12th century AD by the crusaders. It would have been captured by Saladin in 1170, and subsequently rebuilt. However, renewed analysis of the historical documents now suggests that this crusader castle was located on the island of Jazirat Fara'un, along the Egyptian coast. The historical origin of Aqaba Castle thus remains unknown; its standing structures mainly show a Mamluk lay-out, representing building activities from the beginning of the 16th century, and more recent alterations. However, older structures are buried under the standing building complex. Material has been excavated dating back to the Early Islamic (Ummayyid, Abbasid, Fatimid) periods (7th–12th century AD) and the Ayyubid period (end of the 12th–13th century), but the nature of this material (and its relation to the buildings) is not yet well understood. Some Roman artefacts have even been recovered; unfortunately their stratigraphic and taphonomic nature cannot yet be interpreted properly. As far as known at present, possible Roman activity at the site bears no relationship with the later medieval occupation. In any case, the site has a long history, possibly starting in the Early Islamic period and ranging into recent times (see [Table](#)

The aim of the fieldwork was to undertake a complete survey and structural interpretation of the building remains and the underlying structures, and to document the chronological sequence of occupation at the site. The reconstruction of aspects of daily life did not take prime importance, but from the large amount of animal remains the chance was taken to study at least part of the food economy, as it was evidenced for different occupation phases. The main interpretation problem when doing so, remains, however, that the nature of the many different uses of the Aqaba site are poorly understood. The excavations and the available historical information show that the building must have been used during the medieval period as a military stronghold, a *khan*, a fortified caravanserai, and a trading post. It was indeed strategically well located, not only along the main Islamic pilgrimage routes, but also along trade routes leading from Egypt to Arabia and from Syria to the Red Sea. During the Ottoman period, the site must also have served many purposes before it became a military fort around 1840. During the First World War, it was captured by the Arabian Revolt, an event best known in the West by the contribution of T. E. Lawrence, also known as 'Lawrence of Arabia'.

The varying nature of the occupants of the site makes it difficult to go into details when reconstructing dietary patterns. Their status remains unclear (local elite, tradesmen, soldiers, pilgrims) just like any social differentiation within the site. Moreover, most animal remains were derived from secondary contexts of reworked consumption refuse and are thus hard to relate to functional areas within the building. The following analysis must thus be seen only as a broad diachronic approach to the archaeozoology of the site and its region.

Material and methods

A first analysis of the animal material was performed on site during a study session for two weeks in 2005 (by AE). Due to time constraints, it was decided to focus only on the material from the 2003 and 2005 campaigns. The contexts excavated during these field seasons have yielded the largest finds assemblages and are the best understood stratigraphically. The animal remains of the subsequent 2006 and 2007 campaigns (with exception of the shells) were exported to Belgium and are now stored at the RBINS (Royal Belgian Institute of Natural Sciences). The material from these campaigns has consequently been studied there (by MU & BDC). A second session of

field work was then carried out in 2008 (by BDC). The animal remains that were collected during that campaign were studied on that occasion, as well as the shells from the 2006 and the 2007 campaigns. The entire assemblage of fish remains was examined at the RBINS (by WVN & WW).

The animal remains have been almost exclusively handcollected. Although manual recovery of animal material inevitably implies the loss of small remains, it should be noted that the hand collecting during the excavations has been performed with considerable care. This is at least suggested by the often small dimensions of the finds and by the fragility of some of the material, e.g., the fish remains. Additionally, during the study session of 2005, soil samples (ca. 7 litres) were taken in order to check the extent of the loss of small material. After drying in the sun, these samples were sieved using a 0.5mm mesh width. The residue was then subdivided into a '>2mm' fraction and a '<2 mm' fraction. The former part of the residue included some small but sometimes identifiable animal remains, while in the latter fraction only bone and shell fragments were found that could not be identified. In both fractions, the finds density was rather low. Given the time constraints of the excavations, more extensive sieving efforts thus seemed hardly justifiable. However, an exception was made when a ceramic container was found that must have served as a sinkhole in one of the rooms' floors. The contents of this object have been recovered completely and have been dry sieved on a 0.5mm mesh. The same was done when a small water reservoir was found.

Table 31.1. Chronological units retained during analysis (as material from the Ayyubid and Mamluk periods could not always be differentiated easily, these periods have been grouped in the discussion of the finds).

<i>Period</i>	<i>Date (centuries AD)</i>	<i>No. finds</i>
Early Islamic (Ummayyid, Abassid, Fatimid)	7th–12th	655
Ayyubid period	end 12th –13th	50
Mamluk period	end 13th–15th	10692
Ottoman period	16th–19th	14523
Modern period	beginning 20th	9727
Undated (also inc. (sub)recent & mixed material)		1155

For this study the fauna was lumped into five chronological units, dating from the Roman period up to the early 20th century (Table 31.1). Most of the finds (almost 69 %) belong to the Mamluk and Ottoman periods, and there is also a substantial portion of Modern

material (26.4 %). The early phases (*i.e.* Early Islamic and Ayyubid/Mamluk) are very poorly represented (1.9 %). The scarce Roman material has not been retained in the tables and is only occasionally mentioned, as this material is not related to the castle. Some (sub) recent material was collected from the top, and this material has been lumped together with the undated or mixed material. Since the pottery study is not yet finished, dates in this report are preliminary.

Description of the faunal material

In the following paragraphs the different animal taxa identified will be briefly commented upon. Although small pieces and large blocks of coral have been found in many contexts, no attempt was made to identify these specimens to species level. These corals are fossils, and are not part of the archaeozoological assemblage. They are therefore omitted from this report.

Molluscs

The identification of the mollusc shells has produced a long list of taxa (Table 31.2). The shells have been identified using Sharabati (1984). The continuous changes in nomenclature, the determination of new species etc. (see e.g. Rusmore-Villaume 2008) implies that some of the scientific names used during the fieldwork might now be incorrect. Nevertheless, with the exception of the giant clams (see further), it has been decided to continue with the morphotypes and taxonomic names as given in Sharabati (1984).

Table 31.2. Taxonomic representation of the molluscs and Echinodermata and the number of their remains (: almost all collected from the same context).*

	<i>Early Ist</i>	<i>Ayy/Mam</i>	<i>Maml</i>	<i>Ott</i>	<i>Mod</i>	<i>undated</i>
Cephalopoda						
Sepiidae	—	—	7	1	—	—
Polyplocophora						
Chitonidae						
(<i>Acanthopleura haddoni</i>)	3	—	18	2	46*	—
Gastropoda						
Vermetidae						
<i>Dendropoma maxima</i>	—	—	—	—	1	—
<i>Vermetus</i> sp.	—	—	5	4	7	—
Fissurellidae						
<i>Emarginula rigosa</i>	—	—	—	1	—	—
Patellidae						
<i>Patella</i> sp.	—	—	4	7	2	—
<i>Cellana eucosmia</i>	—	—	1	—	1	—
Planaxiidae						
<i>Planaxus sulcatus</i>	—	—	—	—	1	—
Neritidae						
<i>Nerita polita</i>	—	—	2	—	15*	—
<i>Nerita albicilla</i>	2	—	27	16	30	1
Trochidae						
<i>Trochus maculatus</i>	—	—	—	2	—	—
<i>Tectus dentatus</i>	6	1	63	39	15	1
<i>Tectus virgatus</i>	—	—	—	2	5	1
<i>Cianculus pharaonius</i>	—	—	—	6	1	—
Turbinidae						
<i>Turbo radiatus</i>	8	—	42	43	11	1
operculum cf. <i>Turbo radiatus</i>	3	—	23	23	6	1
Cerithiidae						
<i>Cerithium</i> sp.	—	—	1	—	1	—
<i>Cerithium erythraeonense</i>	2	—	11	7	4	—
Strombidae						
<i>Strombus gibberulus albus</i>	4	—	23	32	27	1
<i>Strombus fasciatus</i>	—	—	1	—	1	—
<i>Strombus urecus</i>	—	—	—	1	2	—
<i>Strombus bulla</i>	—	—	1	—	—	1
<i>Lambis truncata sebae</i>	3	1	28	31	11	1
<i>Strombus tricornis</i>	11*	—	24	54	—	11
<i>Strombus decorus persicus</i>	—	—	1	—	—	—
<i>Strombus</i> sp.	—	—	2	5	—	—
Cypraeidae						
<i>Cypraea annulus</i>	—	—	1	—	—	—
<i>Cypraea pantherina</i>	—	—	—	—	2	—
<i>Cypraea caurica</i>	—	—	7	6	1	—
<i>Cypraea turdus</i>	—	—	12*	10	—	—
<i>Cypraea moneta</i>	—	—	2	1	3	—
<i>Cypraea nebrities</i>	1	—	8	4	2	2
<i>Cypraea</i> sp.	1	—	18	11	9	2
Ovulidae						
<i>Calpurnus verrucosus</i>	—	—	—	—	1	—
Naticidae						
<i>Polinices tumidus</i>	1	—	4	3	—	—
<i>Polinices melanostomus</i>	1	—	3	—	3	—
<i>Polinices</i> sp.	—	—	1	—	—	—
Cassidae						
<i>Casmaria ponderosa</i>	—	—	—	2	2	—
Tonnidae						
<i>Malea pomum</i>	—	—	1	1	—	—
Bursidae						
<i>Tarfia bubo</i>	—	—	—	1	—	—
Cymatiidae						
<i>Charonia tritonis</i>	—	—	2	4	—	—
<i>Distorsio anus</i>	—	—	—	1	—	—
<i>Cymatium aquatile</i>	—	—	2	1	—	—
<i>Cymatium rubeculum</i>	—	—	—	—	1	—
<i>Cymatium trilineatum</i>	—	—	—	—	3	—
Muricidae						
<i>Chicoreus virgineus</i>	—	—	—	—	3	—
<i>Chicoreus ramosus</i>	—	—	1	—	—	—
<i>Chicoreus</i> sp.	—	—	5	—	—	—
<i>Muricidae</i> sp.	—	—	1	2	—	—

	<i>Early Ist</i>	<i>Ayy/Mam</i>	<i>Maml</i>	<i>Out</i>	<i>Mod</i>	<i>undated</i>
Thaididae						
<i>Morula granulata</i>	—	—	—	—	1	—
<i>Drupa morum morum</i>	—	—	—	1	—	—
<i>Thais savignyi</i>	—	—	1	—	—	—
<i>Nassa francolina</i>	—	—	3	1	—	—
<i>Rapana rapiformis</i>	—	—	—	1	—	—
Buccinidae						
<i>Engina mendicaria</i>	—	—	—	2	—	—
<i>Engina</i> cf. <i>alveolata</i>	—	—	1	—	—	—
Nassariidae						
<i>Nassarius</i> cf. <i>arcularius</i>	—	—	1	—	—	—
Fascioliariidae						
<i>Latirus polygonus</i>	2	—	5	7	1	—
<i>Pleuroplaca trapezium</i>	1	—	6	5	—	—
<i>Fusinus leptorhynchus</i>	—	—	—	1	7	—
<i>Fusus polygonoides</i>	—	—	3	6	1	—
Colubrariidae						
<i>Colubraria</i> cf. <i>obscura</i>	—	—	—	1	—	—
Harpidae						
<i>Harpa amouretta</i>	1	—	1	1	2	—
Turbellidae						
<i>Vasum turbinellum</i>	—	—	2	1	—	—
Costellariidae						
<i>Vexillum amabilis</i>	—	—	1	—	—	—
<i>Vexillum</i> sp.	—	—	—	1	—	—
Conidae						
<i>Conus taeniatulus</i>	—	—	—	—	1	1
<i>Conus</i> cf. <i>fulgeirum</i>	—	—	—	3	—	—
<i>Conus virgo</i>	—	—	—	1	—	—
<i>Conus arenatus</i>	—	—	4	3	4	—
<i>Conus tessulatus</i>	—	—	1	2	1	—
<i>Conus generalis maldivus</i>	—	—	1	2	4	1
<i>Conus vexillum</i>	—	—	1	1	1	—
<i>Conus namocanus</i>	—	—	—	2	—	—
<i>Conus striatellus</i>	—	—	—	1	—	—
<i>Conus 'pennaceus'</i>	—	—	1	2	2	—
<i>Conus textile</i>	—	—	1	3	3	—
<i>Conus</i> sp.	5	—	25	37	31	—
Terebridae						
<i>Terebra affinis</i>	—	—	1	1	1	—
<i>Terebra crenulata</i>	—	—	—	3	1	—
<i>Terebra dimidiata</i>	—	—	—	1	—	—
Pyramidellamorpha						
<i>Pyramidella 'sulcata'</i>	—	—	3	1	—	—
<i>Pyramidella</i> sp.	—	—	1	—	—	—
Bivalvia						
Arcidae						
<i>Barbatia tenella</i>	1	—	—	—	—	—
<i>Barbatia</i> cf. <i>histrigata</i>	—	—	—	2	—	—
<i>Barbatia fusca</i>	—	—	—	1	—	—
<i>Barbatia helblingi</i>	—	—	—	—	1	—
<i>Barbatia</i> sp.	—	—	—	1	—	—
<i>Anadara antiquata</i>	—	—	5	11	4	—
<i>Anadara uropigmelana</i>	—	—	4	11	2	—
<i>Anadara</i> sp.	—	—	2	1	—	—
Mytilidae						
<i>Brachidontes variabilis</i>	—	—	3	1	—	—
<i>Modiolus auriculatus</i>	—	—	—	—	5	—
<i>Mytilidae</i> sp.	1	—	1	2	—	—
Pteriidae						
<i>Pinctada margaritifera</i>	—	1	25	14	16	1
<i>Pinctada radiata</i>	—	—	1	4	—	—
<i>Pinctada squamosa</i>	—	—	1	—	—	—
<i>Pinctada</i> sp.	—	—	3	2	7	—
Ostreidae						
<i>Dendrocyca foitium</i>	—	—	—	—	1	—
Gryphaeidae						
<i>Hyotissa numisma</i>	—	—	6	3	—	—
Limidae						
<i>Lima paucicostata</i>	—	—	—	1	—	—

	<i>Early Isl</i>	<i>Ayy/Mam</i>	<i>Maml</i>	<i>Ott</i>	<i>Mod</i>	<i>undated</i>
Chamidae						
<i>Chama rupelli</i>	1	—	7	5	17	1
<i>Chama pacifica</i>	—	—	—	5	—	—
<i>Chama</i> sp.	3	—	22	39	—	—
Spondylidae						
<i>Spondylus aurantius</i>	—	—	1	—	—	—
<i>Spondylus</i> cf. <i>marisrubri</i>	—	—	—	1	—	—
<i>Spondylus hystrix</i>	—	—	1	—	—	—
<i>Spondylus</i> sp.	—	—	1	5	—	—
Tridacnidae						
<i>Tridacna maxima</i>	2	6	75	121	11	1
<i>Tridacna squamosa</i>	—	1	39	67	2	—
<i>Tridacna</i> sp.	13	4	130	56	149	6
Cardiidae						
<i>Trachycardium 'flavum'</i>	—	—	3	1	—	—
<i>Laevicardium papyraceum</i>	—	—	1	2	—	—
<i>Cardiidae</i> sp.	—	—	2	1	—	—
Mesodesmatidae						
<i>Atactodea glabrata</i>	—	—	3	10	3	—
Glycymeridae						
<i>Glycymeris petunculus</i>	—	—	21	31	8	—
Lucinidae						
<i>Ctena divirgens</i>	—	—	1	—	—	—
Veneridae						
<i>Circe calipyga</i>	—	—	1	6	2	—
<i>Circe corrugata</i>	—	—	1	4	—	—
<i>Venus verrucosa</i>	—	—	1	1	—	—
<i>Marcia hiantina</i>	—	—	2	5	1	—
<i>Veneridae</i> sp.	—	—	—	2	—	—
Tellinidae						
cf. <i>Telinella staurella</i>	—	—	1	—	—	—
cf. <i>Angulus corbis</i>	—	—	—	1	—	—
Plicatulidae						
cf. <i>Plicatula plicata</i>	—	—	1	—	—	—
Ostreidae						
<i>Saccostrea cucullata</i>	1	—	7*	—	41	—
<i>Ostreidae</i> sp.	—	—	—	3	8	1
mother of pearl fragments	—	—	15	7	1	—
Identified molluscs	77	15	802	841	557	35
Unidentified molluscs	36	1	225	143	118	20
Echinodermata						
Echinoidea	1	—	8	13	11	—
Clypeasteroidea	—	—	—	1	—	—

The giant clams are the best represented among the mollusc shells. The two species that occur in the Gulf of Aqaba according to Sharabati (1984) are *Tridacna squamosa* and *T. crocea*. However, more recent research (e.g. Roa-Quiaoit 2005) reveals that the latter identification is incorrect. *T. crocea* (as defined by recent taxonomy) is not present in the Red Sea but *T. maxima* is. Both species are indeed present in the finds collections and are described as living on the surface of shallow coral reefs, although adult specimens of *T. maxima* are more common on the reef flat (<3m) than on the deeper fore-reef (9–15m) whereas adult *T. squamosa* are common on the deeper fore-reef. Over-exploitation of the giant clam as a food resource, together with habitat loss has depleted stocks (Roa-Quiaoit 2005). Many of the giant clam finds consist of heavily fragmented shells, and therefore, part of the remains has not been identified to species level, especially during the

first field season when mainly Modern material was dealt with. Interestingly enough *T. maxima* and *T. squamosa* occur in about the same ratios during the Mamluk and the Ottoman period (approximately 65% and 35% respectively). This corresponds to their natural abundance in the Gulf of Aqaba (mean abundance of *T. maxima* being 0.5 ± 0.3 ind/m² and of *T. squamosa* 0.3 ± 0.2 ind/m²; Roa-Quiaioit 2005, 29). Considering the fact that the species inhabit different areas within the reef – reef flat *versus* deeper fore-reef – this indicates that the harvest of giant clams was undertaken within the whole reef area.

Other frequently identified taxa belong to, among others, the top shells (*Tectus dentatus*), turbans (*Turbo radiatus*), conch shells (*Strombus tricornis*, *Strombus gibberulus albus*, *Lambis truncata sebae*), pearl oysters (*Pinctada* sp.), jewel boxes (*Chama* sp.) and bittersweet clams (*Glycymeris* sp.). In fact, the conch shells, the turbans and the top shells together constitute more than 50% of the gastropods. They can all be found on shallow reef flats or in intertidal water (Sharabati 1984) and are easily accessible. Therefore, the majority of the molluscs can most probably be considered as consumption refuse, as it was the case with the giant clams. This is also indicated by the fact that in several instances concentrations of shells have been found, e.g., *Nerita polita*, *Strombus tricornis* and *Saccostrea cucullata*. However, there were also shells with an eroded surface, probably due to transportation by the tides, showing that not all the molluscs were eaten. Still other molluscs cannot be considered as consumption refuse because they are poisonous, such as the cone shells. Their shells, just like the complete cowries that were found in the castle, may have been collected for decorative purposes, eventually as raw material for shell working. Mother of pearl – listed separately in [Table 31.2](#) – was also used as raw material, as shown by some worked items, but the pearl oysters may also have been a source of food. The spectrum of the different shell taxa identified at the castle corresponds to that observed by AE in 2005 on the rocky shores of Jazirat Fara'un along the Egyptian Red Sea coast.

In a few contexts internal shells of squids (Sepiidae) have been found (n=8), and several assemblages contained plate fragments of mail shells (Chitonidae). In the latter case, there was even a concentration found – in a Modern context – which suggests that they were also eaten.

Echinodermata

Fragments of the body skeleton of a sea urchin (Echinoidea) were

found in a few cases, possibly representing consumption refuse. The body skeletons of sea urchins are rather fragile, which might explain the fact that they have not been collected frequently. Many finds loci, however, contained solid, heavy sea urchin spines with a diameter of up to 7–8 mm. It is, however, believed that these spines may also form part of the geological record. No species identifications have been attempted. In one case the body of a sand dollar (Clypeasteroidea) was collected.

Fish

More than 20 different fish taxa have been identified. With one exception, all taxa are marine and are mainly bony fish, but there are also some cartilaginous taxa such as sharks (Carcharinidae and Sphyrnidae) and rays (Rhynchobatidae). The taxonomic distribution of the fish remains for each period is given in [Table 31.3](#) and the size reconstructions, based on direct comparison with modern fish of known body size, are given in [Figure 31.3](#). The fish bones from the sieved sediment samples are listed separately ([Table 31.4](#)). The best represented groups of the hand-collected list are – in almost equal numbers – the groupers (Serranidae), the emperors (Lethrinidae) and the jacks (Carangidae), followed by the parrotfishes (Scaridae). These four groups constitute together more than 89 % of the identified fish remains which totally come up to 1513 specimens.

Most of the fish taxa listed in [Table 31.3](#) can be classified as either coastal or reef-associated fish. Only a few taxa, i.e. the jacks, the thunnids (Scombridae) and the sharks and rays occur in the open sea. However, it is known that some jack and shark species can be found closer to the coast, especially in the case of juvenile animals (Desse & Desse-Berset 2003). Considering the main size of the jacks, i.e. 50cm and larger ([Fig. 6](#)), and the large size of the requiem sharks (Carcharinidae), i.e. more than 1.5m, it is assumed here that they were captured offshore.

From the data in [Table 31.3](#) it is clear that the coastal fishes are much better represented than those from the open sea, respectively around 75% and 25% ([Fig. 31.4](#)). However, a steady increase in the proportion of the open sea fishes is visible from the Mamluk period into Modern times ([Fig. 31.4](#)). The proportion of the groupers (Serranidae) and parrotfishes (Scaridae) also varies through time ([Fig. 31.5](#)). While during the Mamluk period the parrotfishes are the most common, their numbers decrease in favour of the groupers during the Ottoman period. In Modern times both taxa become about equally important. The proportion of the emperors remains more or less

constant through time.

When the standard lengths of the main four taxa are considered, diachronic shifts in size are noticed (Fig. 31.3). For example, smaller-sized groupers are represented during the Ottoman period compared to the Mamluk period; while the emperors attain larger sizes for the same period. In the case of the jacks, the size range is narrower during the Ottoman period with fishes occurring almost exclusively in the size intervals of 40–60cm and 60–80cm.

In an Ottoman context the presence of the catfish (*Clarias* sp.) is attested by a suboperculum of an animal that measured 70–80cm SL. This freshwater fish cannot be derived from local fishing, but must have been imported to the site. The closest possibility is the Jordan basin. On the other hand, considering the location of Aqaba along the trade route from Egypt to Arabia, it may well have been imported from the Nile. Long distance trade of catfish has been observed on numerous other archaeological sites (Arndt *et al.* 2003; Van Neer *et al.* 2004).

Reptiles

Fifteen specimens – almost all dated to the Mamluk period – could be identified as marine turtle (Cheloniidae). With the exception of a vertebra and a coracoid, these are exclusively fragments from the carapace. Due to the fragmentary nature of these finds, species identification was impossible. Although there are four possible candidates (i.e. the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*), the loggerhead turtle (*Caretta caretta*) and the olive ridley turtle (*Lepidochelys olivacea*; Marquez 1984), the green turtle and the hawksbill turtle are now the most common turtle species in the Red Sea (Frazier & Salas 1984)). Considering the low number of their remains, turtles probably only occasionally got stuck in fishing nets and were then brought to land, where they may have been consumed. Alternatively, the remains may come from animals that were stranded, or killed when they came ashore to lay eggs. In any case, the scarcity of the turtle remains does not point towards an organised fishing strategy for these species.

Table 31.3. Taxonomic representation of the hand-collected fish and the number of their remains (: bones from the same individual, counted in total as one).*

	<i>Early Isl</i>	<i>Ayy/Maml</i>	<i>Maml</i>	<i>Ott</i>	<i>Mod</i>	<i>undated</i>
Chondrichthyes	—	—	1	—	—	—
Carcharinidae	—	—	—	2	1	—
Sphyrnidae						
<i>Sphyrna</i> sp.	—	—	—	—	2	—
Rhynchobatidae						
<i>Rhynchobatos</i> sp.	—	—	—	—	1	—
Scombridae						
<i>Thunnus</i> sp.	—	—	—	—	—	1
Chanidae						
<i>Chanos chanos</i>	12	—	—	—	—	—
<i>Chanos</i> sp.	—	—	—	1	—	—
Clariidae						
<i>Clarias</i> sp.	—	—	—	1	—	—
Belonidae	—	—	1	1	—	—
<i>Tylosaurus</i> sp.	2	—	4*/1	—	—	—
Fistulariidae						
<i>Fistularia</i> sp.	—	—	1	3	2	—
Sphyaenidae						
<i>Sphyaena</i> sp.	—	—	1	1	—	1
Mugilidae	—	—	4	7	—	—
Serranidae	6	4	43	10*/246	6*/52	6
Rachycentridae						
<i>Rachycentron</i>	—	—	—	2	—	—
<i>canadum</i>						
Carangidae	9	—	58	179	32	9
<i>Caranx</i> sp.	—	—	7	3	20	12*
<i>Carangoides</i> sp.	—	—	8	—	27	1
<i>Gnathanodon</i>	—	—	1	—	—	—
<i>speciosus</i>						
<i>Seriola</i> sp.	—	—	2	—	—	—
Lutjanidae	—	—	3	28	5	—
Lethrinidae	3	1	122	152	74	6
Sparidae	—	—	4	18	2	—
<i>Acanthopagrus</i> sp.	—	—	—	2	—	—
<i>Argyrops</i> sp.	—	—	2	13	7	4*/2
<i>Rhabdosargus</i> sp.	—	—	1	—	—	—
Labridae	—	—	1	8	—	—
Scaridae	—	—	33	8	9	—
<i>Cetoscarus</i> sp.	—	—	8	5	1	—
<i>Hipposcarus</i> sp.	—	—	14	1	—	—
<i>Scarus</i> sp.	8	—	110	40	25	7
<i>Coris aygula</i>	—	—	3	—	—	—
<i>Coris</i> sp.	—	—	2	1	3*/2	—
Siganidae	—	—	1	—	—	—
Balistidae	—	—	1	5	6	1
Diodontidae						
<i>Diodon</i> sp.	—	—	—	1	—	—
Identified fish	40	5	433	729	270	36
Unidentified fish	10	2	120	338	84	6

	<i>Early Islamic</i>	<i>Mamluk</i>	<i>Modern</i>	<i>Mamluk sinkhole (AQ 2005 Y11)</i>
<i>mesh width</i>	2mm	2mm	2mm	5mm
Mugilidae	—	4	—	1
Serranidae	—	1	—	—
Carangidae	—	—	—	13
Lethrinidae	—	—	—	46
Sparidae	—	—	—	7
Scaridae			—	
<i>Scarus</i> sp.	2	—	—	4
Siganidae	—	—	—	8
<i>Siganus</i> sp.	—	5	—	15
Identified fish	2	10	0	94
Unident. fish	15	63	6	753

Table 31.4 Taxonomic representation of the fish and the number of their remains, from the sieved samples.

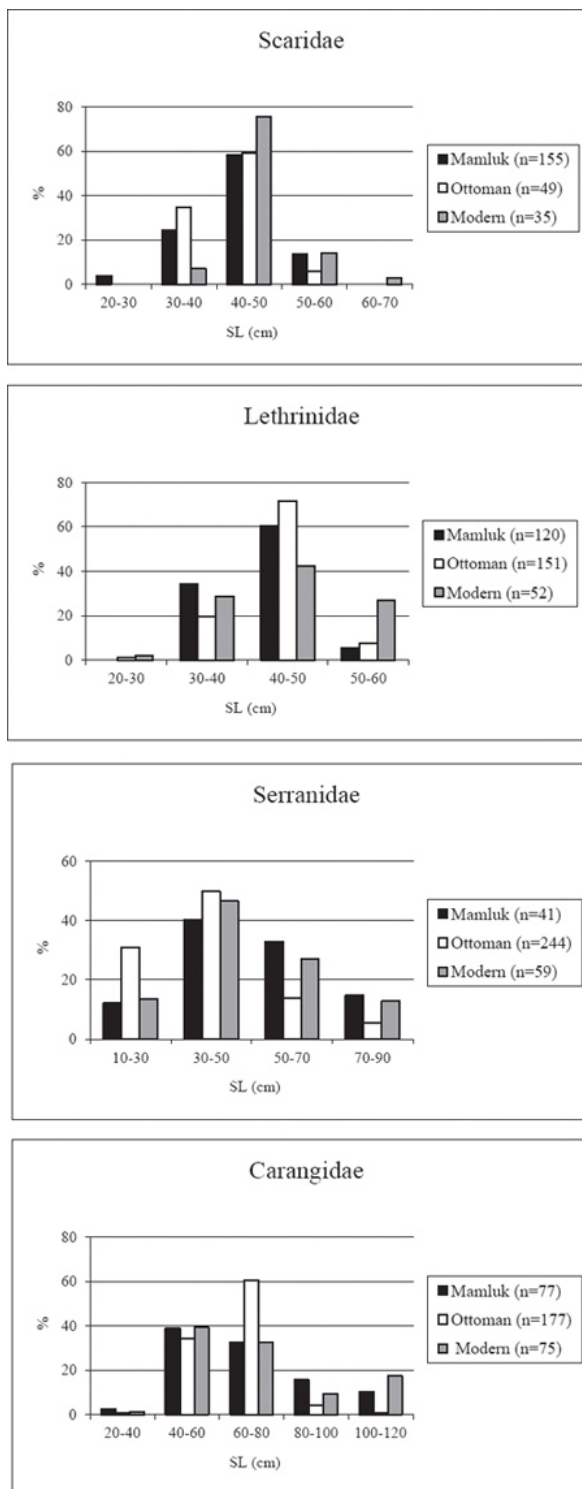


Fig. 31.3. Distribution of the standard length (SL) of the main fish taxa.

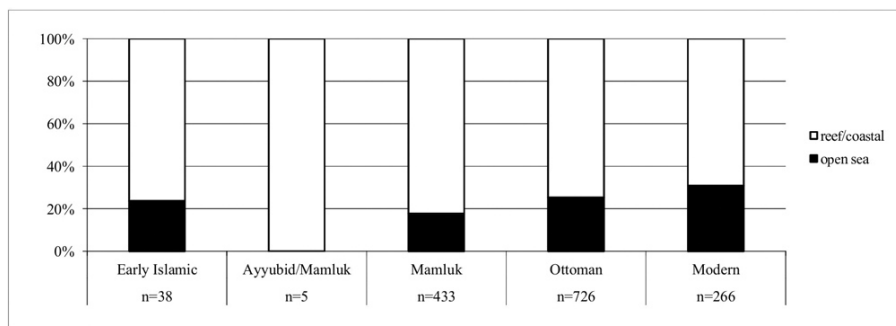


Fig. 31.4. Relative abundance of the fish from the open sea versus coastal fish and fish from the reefs; based on the hand collected material.

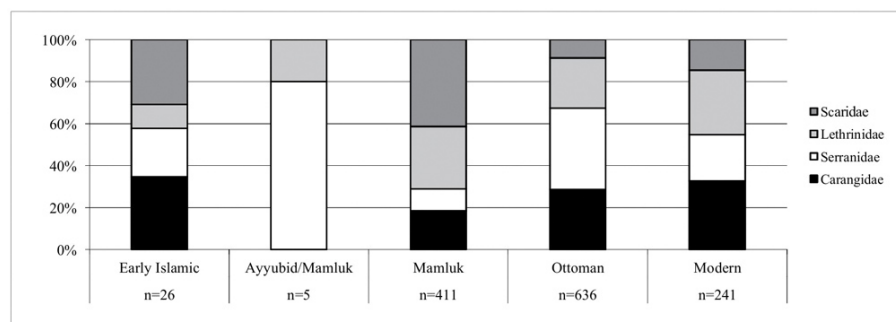


Fig. 31.5. Relative abundance of the four best represented fish families; based on the hand collected material.

Birds

The relative abundance of bird bones compared to the total faunal assemblage – molluscs excluded – is low. More than half of the bird bones belong to chicken but, still, a rather large number of species could be identified (Table 31.5). This variety can be explained by the fact that Jordan lies on one of the world's major bird migration routes, from Africa to Eurasia. Also, the geographic location of the castle implies that both sea- or coastal birds and inland birds can be expected.

Egg shells of ostrich (*Struthio camelus*) have been collected three times, twice from a Mamluk and once from an Ottoman context. No bone fragments of this species have however been found. The great black cormorant (*Phalacrocorax carbo*) is represented by several specimens. Only two bones could be measured, an ulna (Bp 12.8mm; Dp 11.0mm) and a tarsometatarsus (GL 61.4mm; Bp 14.0mm; SC 7.0mm; Bd 15.5mm), both from (sub)recent contexts. The latter

specimen had cut marks on its dorsal side. Another specimen with cut marks is a tibiotarsus from a pelican that was dated to the Modern period. Only the white pelican (*Pelecanus onocrotalus*) occurs in the region (Andrews 1995), although some field guides (e.g. Heinzel *et al.* 1987) suggest that the Gulf of Aqaba falls within the geographical distribution of both the white pelican and the Dalmatian pelican (*P. crispus*). Since there is size overlap between the bones of both species (Lorch 1992), the Aqaba finds could not be identified any further. The great bittern (*Botaurus stellaris*) is represented by an incomplete skeleton which was dated to the Mamluk period. Only the coracoid could be measured (GL 66.2mm; Lm 62.7mm; Bb 22.9mm; BF 18.8mm). Six bones were identified as stork (*Ciconia* sp.). Two species occur in Jordan, the white stork (*C. ciconia*) and the black stork (*C. nigra*). White stork is an abundant migrant through Jordan, especially in autumn, while the black stork is rather uncommon (Andrews 1995). Since there is size overlap between both species, morphological characteristics should be used to distinguish bone material from both species (Gruber 1990). One specimen, a coracoid dated to the Modern period, most closely resembles that of black stork (cf. Gruber 1990, Abb. 28:13). The other finds are too fragmentary to be identified to species level. Cut marks were observed on a proximal end of a coracoid dated to the Mamluk period.

Despite the large number of ducks and geese that occur in Jordan, the Anatidae family is poorly represented. Seven bones have been identified as greylag goose (*Anser anser*); five of them were collected from the same Early Islamic context and are probably from one individual. In terms of morphology and size, the duck remains fall within the variation of common teal (*Anas crecca*), mallard (*Anas platyrhynchos*) and pintail (*Anas acuta*), but were not identified with certainty. A humerus (GL 60.8mm; Bp 13.4mm; SC 4.7mm; Bd 9.4mm) was attributed to the common teal, a carpometacarpus (GL 56.1mm; Bp 12.9mm; Bd 7.3mm) to the pintail, and a skull and a sternum to the mallard.

Remains of a large vulture were tentatively identified as lammergeier (*Gypaetus barbatus*). Some elements, most probably from the same individual, could be measured, i.e. an ulna (Bp 25.7mm; Dip 27.1mm; SC 11.5mm; Bd 20.8mm), a radius (GL $\pm$ 235mm; SC 11.3mm; Dd 15.9mm) and a carpometacarpus (GL 112.6mm; Bp 27.8mm; Bd 21.4mm). One of the two specimens that were dated to the Mamluk period, a carpometacarpus, showed cut marks.

The carcass of an Egyptian vulture (*Neophron pernocteropus*) was collected from a Mamluk context. Within the same trench, a skull was

found that probably belongs to the same individual. Several elements could be measured, i.e. a coracoid (GL ± 54 mm; Lm 48.6mm), two femurs (GL 69.0 mm/-; Bp 19.3mm/18.6mm; Dp 11.6mm/11.7mm; SC 8.4mm/-; Bd 18.9mm/-; Dd 13.0mm/-), a tibiotarsus (SC 7.3mm/-; Bd 15.2mm/14.7mm; Dd 10.5mm/10.3mm) and a tarsometatarsus (Bp 15.7mm).

Several raptor bones comparable with *Buteo* sp. were found. Three species of buzzard occur in Jordan, i.e. common buzzard (*Buteo buteo*), rough-legged buzzard (*B. lagopus*) and long-legged buzzard (*B. rufinus*). The common buzzard could be identified with certainty in three instances. Measurements taken on these bones are from a coracoid (GL 41.0mm; Lm 36.7mm; Bb 19.6mm; BF 15.9mm) and a tibiotarsus (SC 5.4mm; Bd 11.2mm). Two tarsometatarsals (GL 71.6mm/72.9mm; Bp 12.7mm/12.4mm; SC 5.4mm/5.6mm; Bd 12.9mm/13.0mm) exclude identification as long-legged buzzard and were hence labelled *Buteo buteo/lagopus*. Measurements of *Buteo* sp. were taken on a humerus (GL 100.0mm; Bp ± 20.5 mm; SC 7.7mm; Bd 18.0mm) and a carpometacarpus (GL 59.0mm). One accipitrid bone could not be identified to genus level; this specimen was of a rather large size.

The chukar (*Alectoris chukar*) and the sand partridge (*Ammoperdix heyi*) – both resident and fairly common in Jordan (Andrews 1995) – were found in contexts dated to the Mamluk and Ottoman periods. Their remains are (almost) completely absent in the Modern period. Measurements of chukar and sand partridge are given in the appendix.

Unlike the moorhen (*Gallinula chloropus*) and the coot (*Fulica atra*), which are winter visitors, the corncrake (*Crex crex*) is a spring migrant (Andrews 1995). A skeleton of the latter was found in an Ottoman context, while several other isolated finds have been found in contexts of the Mamluk, Ottoman and Modern periods. Measurements were taken on the bones of the moorhen, i.e. on a humerus (GL 46.9mm; Bp 9.0mm; SC 3.0mm; Bd 6.0mm) and an ulna (GL 42.5mm; Bp 4.6mm; Dip 5.7mm; SC 2.1mm; Did 4.6mm), and in the case of coot, on a femur (GL 54.4mm; Bp 10.1mm; Bp 7.2mm; Dip 4.4mm; Bd 9.8mm; Dd 8.0mm). Measurements of the corncrake are given in the appendix.

More than 10 different gull species (*Larus* sp.) can be seen today at the Gulf of Aqaba. Considering the size overlap of some of these species and the lack of adequate reference material, no attempt was made to identify the gull remains from the Aqaba Castle to species level. In size, however, most were comparable with the lesser black-backed gull (*Larus fuscus*). Large flocks of this gull are frequently seen on spring passage – April/June – while fewer birds pass through in

autumn, from late September to mid October (Andrews 1995). Measurements were taken on some post-cranial elements and included coracoid (Lm 48.7mm), scapula (Dic 11.5mm), humerus (SC 7.3mm; Bd 17.4mm), ulna (Bp 12.9mm/12.0mm) and carpometacarpus (GL 73mm; Bp 14.7mm). The skeletal remains of a carcass were found in an Ottoman context, while one specimen, a distal humerus, showed cut marks on the distal articulation surface. The latter was also dated to the Ottoman period.

In terms of size almost all pigeon remains could be attributed to rock or stock pigeon (*Columba livia/ oenas*), while the presence of the larger-sized woodpigeon (*Columba palumbus*) could be excluded. Some bones were identified as dove (*Streptopelia* sp.). The skeletal remains dated to the Ottoman period, should most probably be classified as turtle dove (*S. turtur*). Indeed, other species from this genus, i.e. the collared dove (*S. decaocta*) and the palm dove (*S. senegalensis*) have only recently colonised Jordan; the same is true for the Namaqua dove (*Oena capensis*) (Andrews 1995). Measurements are given in the appendix.

The barn owl (*Tyto alba*) is represented by a tarsometatarsus (GL 61.8mm; Bp 9.3mm; SC 3.9mm; Bd 10.3mm); the specimen has been dated to the Ottoman period. Although breeding has been reported in the northwest of the country, birds seen elsewhere are more likely to be passage migrants (Andrews 1995). Four bones of eagle owl (*Bubo bubo*) have been identified. An ulna, dated to the Ottoman period, could be measured (Bp 14.1mm; Dip 16.2mm; SC 5.7mm) as well as a carpometacarpus from the Modern period (GL 70.8mm; Bp 15.5mm; Did 11.9mm). A tibiotarsus from the Mamluk period showed a chop mark at its distal end.

*Table 31.5. Taxonomic representation of the bird and the number of their remains (+: egg shell; *: bones from the same individual, counted in total as one).*

	Early Isl	Ayy/Mam	Maml	Ott	Mod	undated
Wild						
Struthionidae						
<i>Struthio camelus</i>	—	—	+	+	—	—
Phalacrocoracidae						
<i>Phalacrocorax carbo</i>	—	—	3	1	2	2
Pelecanidae						
<i>Pelecanus</i> sp.	—	—	—	—	1	—
Ardeidae						
<i>Botaurus stellaris</i>	—	—	11*	—	—	—
Ciconiidae						
<i>Ciconia</i> sp.	—	—	3	2	1	—
Anatidae						
<i>Anser anser</i>	5	—	2	—	—	—
<i>Anas</i> cf. <i>crecca</i>	—	—	—	—	1	—
cf. <i>Anas platyrhynchos</i>	—	—	—	1	1	—
<i>Anas</i> cf. <i>acuta</i>	—	—	—	—	1	—
Accipitridae						
cf. <i>Milvus migrans</i>	—	—	1	—	—	—
cf. <i>Gypaetus barbatus</i>	—	—	2	5*	—	—
<i>Neophron pernocteropus</i>	—	—	15*/1	—	—	—
<i>Accipiter gentilis</i>	—	—	v	1	—	—
<i>Buteo buteo</i>	—	—	1	—	1	1
<i>Buteo buteo/lagopus</i>	—	—	—	1	—	—
<i>Buteo</i> sp.	—	—	—	3	—	—
Accipitridae sp.	—	—	—	—	1	—
Galliformes						
<i>Alectoris chukar</i>	—	—	4	12	1	—
<i>Ammoperdix heyi</i>	—	—	1	3	—	—
Rallidae						
<i>Crex crex</i>	—	—	4	7*/5	3	—
<i>Gallinula chloropus</i>	—	—	—	2	—	—
<i>Fulica ara</i>	—	—	—	1	—	1
Laridae						
<i>Larus</i> sp.	—	—	1	7*/2	1	—
Columbidae						
<i>Columba livia/oenas</i>	1	—	9	7	2	—
<i>Streptopelia</i> sp.	—	—	—	4*	1	—
Strigidae						
<i>Tyto alba</i>	—	—	—	1	—	—
<i>Bubo bubo</i>	—	—	1	2	1	—
Corvidae						
<i>Corvus corax</i>	1	2	8	23	6	1
Domestic						
<i>Gallus gallus</i> f. domestica	1	—	33	99	68	12
<i>Meleagris gallopavo</i> f. domestica	—	—	—	—	—	1
Identified bird	8	2	76	169	92	18
Unidentified bird	1	—	21	19	16	5

The raven (*Corvus corax*) is the best represented wild bird at the Castle of Aqaba. Although several species of *Corvus* are described for Jordan, ravens can easily be recognised by their size (Tomek & Bocheński 2000). When the complete long bones of Aqaba are considered, they all fall well above the size range of the rook (*C. frugilegus*) and the hooded crow (*C. corone*) (see [appendix](#)). Incomplete bones also seemed to belong to ravens. The measurements of the

Aqaba specimens are, however, smaller than those of the European raven (for measurements see Tomek & Bocheński 2000). The smaller fan-tailed raven (*C. rhipidurus*) and the brown-necked raven (*C. ruficollis*), which are common today in the region of Aqaba, seem to be absent among the bird remains of the castle. One coracoid, dated to the Ottoman period, has cut marks.

Table 31.6. Taxonomic representation of the mammals and the number of their remains (: bones from the same individual; counted in total as one).*

	<i>Early Isl</i>	<i>Ayy/Mam</i>	<i>Maml</i>	<i>Ott</i>	<i>Mod</i>	<i>undated</i>
Wild						
<i>Lepus capensis</i>	—	—	8	10	9	—
<i>Rattus rattus</i>	—	—	1	—	—	—
Rodentia	—	—	—	1	—	—
<i>Procapra capensis</i>	—	—	5*	3*/1	—	—
<i>Hyaena hyaena</i>	—	—	4	11	2	—
<i>Gazella dorcas</i>	—	—	—	—	—	1
<i>Gazella subgutturosa</i>	—	—	—	1	—	—
<i>Gazella</i> sp.	1	—	33	96	18	17
Domestic						
<i>Felis silvestris</i> f. catus	—	—	5	4*/2*/2*/37	6*/19	2
<i>Canis lupus</i> f. familiaris	—	—	5	10	10	—
<i>Equus africanus</i> f. asinus	—	—	10	4*/83	4	2
<i>Equus ferus</i> f. caballus	1	—	1	8	2	—
Equidae	—	—	6	14	5	—
Camelidae	34	9	875	1276	368	82
<i>Ovis ammon</i> f. aries	7	1	334	584	293	22
<i>Capra aegagrus</i> f. hircus	13	2	272	892	433	21
sheep/goat	153	13	3202	6668	4236	484
<i>Bos primigenius</i> f. taurus	4	—	46	29	10	1
Identified mammal	213	25	4802	9642	5410	632
Unidentified mammal	269	—	4205	2727	3169	403

Only two species of domestic birds could be identified at the site, i.e. the chicken (*Gallus gallus* f. domestica) and the turkey (*Meleagris gallopavo* f. domestica). The latter was represented by one bone only, a distal tibiotarsus, which was found in a (sub)recent context. Chicken bones make up 51% of the identified bird bone assemblage. Measurements display a large variation in size (see [appendix](#)) and it is quite obvious, for example in the case of the ulna and the femur, that the specimens represent chickens of any size between very small to very large. Not only sexual dimorphism but also the existence of chickens belonging to different types or breeds might be responsible for this (De Cupere *et al.* 2005). Both adult and young individuals

were consumed, although the latter group was less well represented.

Wild mammals

The number of wild mammal species is very low (Table 31.6). Remains of hare (*Lepus capensis*) have been collected from contexts dated to the Mamluk period into Modern times, albeit in small numbers only. The black rat (*Rattus rattus*) is represented by a complete skeleton in one single context, dated to the Mamluk period. The black rat is not a burrower and must therefore not be considered as intrusive (Ervynck 2002), but as contemporary to the Mamluk occupation. The mandible of this animal showed a fracture which may explain why the incisors were not able to wear off properly. As a consequence the upper incisors kept growing and formed a complete circle, with the left incisor penetrating the palatal bone (Fig. 31.6). The remains of rock hyrax (*Procavia capensis*) included an incomplete skeleton of a subadult animal, dated to the Mamluk period while for the Ottoman contexts an incomplete skeleton of a juvenile animal and an isolated humerus from a second subadult individual are evidenced. The latter specimen showed fine cut marks, just above the distal articulation, indicating that hyrax indeed was consumed. However, the presence of partial skeletons suggests that remains may also be included from animals that died naturally on the spot.

Most of the remains of the striped hyena (*Hyaena hyaena*) originate from Ottoman contexts; some measurements could be taken (see appendix). Interestingly enough, more than half of the specimens showed cut and/or chop marks. These elements included a scapula, a humerus and a radius from the Mamluk period, a mandible, an axis, two humeri and a pelvis from the Ottoman period as well as a humerus from the Modern period. They could be attributed to both the left and the right side of the body. Cut and chop traces on the bone remains of the striped hyaena were also observed at other sites, e.g. Julfar (8th–17th century) in Ras al-Khaimah (UAE) (Desse & Desse-Berset 2000) and medieval Siraf (4th–16th century) in Iran (von den Driesch & Dockner 2002). In the case of Julfar, the hyaena skulls had fine cut marks on the condyles. The consumption of striped hyaena has been reported at the beginning of the 20th century among the Bedouins of Arabia, although more in terms of a medicinal treatment than being part of a regular meal (Smith 1907, 231). The use of the (striped) hyaena for medical purposes is also described by Ibn al-Baytar (13th century, translated by L. Leclerc 1987, 388–398) and has been listed as ‘*halal*’ by the 14th century Egyptian writer ad-Damiri in his encyclopaedic work ‘*Hayat el-hayawaan*’ or ‘The life of

animals' (Smith 1907). The consumption of hyaena represents an exception to the rule that predatory animals are not to be eaten. Indeed, hyaenas are considered to have weakly developed canines (!) and do not dominate other animals by mean of these teeth. In addition, hyaenas do not attack man, although they were known to be a danger for the domestic livestock. As such their meat – as well as that of fox, weasel, marten and hyrax – is allowed to be consumed (Benkheira 2000, 110–111). It is sometimes mentioned that only the right side of the animal was used for consumption (M. Alzawahra, pers. comm.) but the Aqaba finds do not corroborate this.



Fig. 31.6. Skull of black rat, with unworn upper incisors.

Gazelles are best represented among the wild mammals. On the basis of their geographical distribution, three species of *Gazella* sp. can be expected in Jordan, the dorcas gazelle (*G. dorcas*), the mountain gazelle (*G. gazella*) and the goitred gazelle (*G. subgutturosa*) (Harrison & Bates 1991). The mountain gazelle is a moderately large gazelle; it has a very slender and graceful stature with relatively long limbs. The dorcas gazelle is a small species, of less graceful build than the mountain gazelle and with shorter legs. The goitred gazelle is a large gazelle, heavier built than the mountain gazelle and the dorcas gazelle. At Aqaba, the presence of goitred gazelle is evidenced by a horncore, while a small horn has tentatively been identified as belonging to *G. dorcas*. As E. Vila (1991) and others stated repeatedly, postcranial elements are impossible to separate. The majority of the gazelle remains are from similarly sized animals, but there are also indications for smaller individuals, e.g. in case of the femur (see [appendix](#)). Comparison of the Aqaba data with the measurements of *G. gazella* (Horwitz *et al.* 1990) shows that the finds mostly fall within the size range of the mountain gazelle. The smaller individuals are possibly from the smaller dorcas gazelle.



Fig. 31.7. The 'greyhound of Akkaba' (Smith 1840).

Domestic mammals

Remains of cat (*Felis silvestris* f. *catus*) have been collected more frequently than those of dog (*Canis lupus* f. *familiaris*). In the case of *Felis*, articulating elements could be found in several instances; one bone, a humerus dated to the Modern period, displayed a healed fracture. Measurements of both cat and dog elements are given in the appendix. The dog remains may have belonged to the so-called 'greyhound of Akkaba' (Fig. 31.7) or, more generally, the 'Bedouin greyhound', a large and fierce dog, resembling the Saluki (Richardson 1857, 57). The very few measurements that could be taken on the Aqaba dog remains are comparable to those of the Saluki Luman (see Clutton-Brock 1989).

Donkey (*Equus africanus* f. *asinus*) is much better represented than horse (*Equus ferus* f. *caballus*). It is of course not excluded that remains of mule and/or hinny are present in the equid assemblage but supportive evidence was completely missing. Three complete metatarsals – all dated to the Ottoman period – allowed the calculation of the withers height for donkey, giving 1.07m, 1.15m and 1.16m respectively (using the multiplication factor of Kiesewalter, cited in von den Driesch & Boessneck 1974). No complete long-bones of horse were present. While several of these equid bones were burnt, traces of cutting or chopping were not observed, as in the bones of cat and dog.

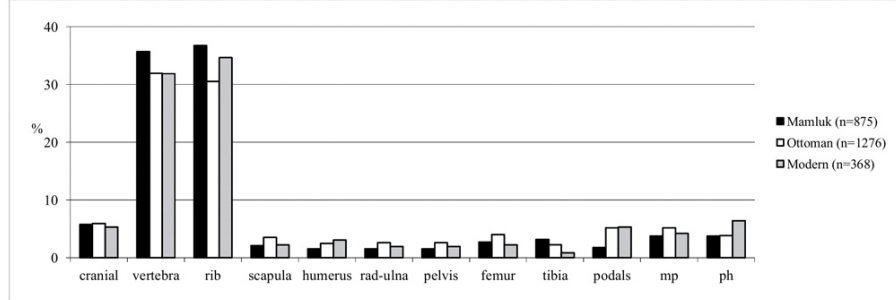


Fig. 31.8. Skeletal distribution of camelids through time.

Camelids are very well represented at the site of Aqaba ($n=2644$). Their remains were – unlike those of the other mammals – brittle and not well preserved. Complete bones or measurable parts of bones mainly included compact bones such as carpals, tarsals, proximal and distal ends of metapodials, and phalanges. Nevertheless, vertebrae and ribs were also very well represented. Indeed, when looking to the skeletal element distribution, the long-bones of the fore and hind limb were under-represented (Fig. 31.8). Chop and cut marks were regularly observed both on adult and subadult specimens. Articulating bones from the wrist and ankle joint, in combination with a chopped proximal metapodial, were found in several contexts. Some vertebrae and ribs probably also originated from the same individual. Traces of fire have been frequently noted; in these cases the bones were only slightly charred (showing a brown to black colour). Although suggested by the archaeologists, there was no true evidence for the deposition of camelid carcasses at the site. All camelid remains were interpreted as consumption refuse.

The identification of the camel remains to species – Bactrian camel (*Camelus ferus* f. *bactrianus*) or dromedary (*Camelus thomasi* f. *dromedarius*) – was carried out using the osteomorphological differences described in literature (Wapnish 1984; Steiger 1990; Studer & Schneider 2008). These largely corroborate an identification of this material as dromedary, as expected when the geographical distribution of the two species is considered (Mason 1984, 112). However, one specimen – a proximal metacarpus, dated to the Ottoman period – exhibited more closely the characteristics of Bactrian camel, while another find – a first phalanx – that showed intermediate characteristics of camel and dromedary was interpreted as a hybrid. Some skeletal elements, on the other hand, clearly showed all morphological characteristics of dromedary, but were very large, falling outside the ‘normal’ size range of dromedary. These included, among others, two proximal radii, a complete metacarpus,

three 1st phalanges and three 2nd phalanges, all dated to the Ottoman period, as well as several carpals and tarsals. It is believed that these large camelid bones may derive from castrated dromedaries, rather than from hybrids. Indeed, males can have a bad temper and are easier to manage when castrated (Wilson 1998, 76–77). Such large animals, morphologically similar to dromedary, have also been identified at Nabatean Petra (Studer & Schneider 2008). The presence of the wild form, which had already become extinct some millennia before, can be excluded (Peters 2001). Considering the location of the Castle of Aqaba along major trade routes, it is possible that Bactrian camels may have come as far south as Aqaba with caravans. The possible presence of camel hybrids was already attested for Jordan at Early Islamic Pella (Köhler-Rollefson 1989); other archaeological sites include Troy (Turkey) and Mleiha (UAE) (Uerpmann 1999). Hybrids are much larger and stronger than either parent, and are therefore much appreciated as a draft animal (Potts 2004). A full discussion of the camelid finds, together with a more detailed description and an analysis of the measurements taken, is still in preparation (by BDC) and will be published elsewhere.

The mammal bone assemblages are without exception dominated by the remains of sheep (*Ovis ammon* f. *aries*) and goat (*Capra aegagrus* f. *hircus*), which form more than 86% of the identified mammal bone assemblage (see Fig. 31.7). The majority of the sheep must have been of a hornless breed; only a few isolated horn cores were encountered and, in addition, several skull fragments of sheep without horn-cores have been observed. In contrast, from goats, many well preserved horn-cores and cranial fragments with the base of a horn-core were found. All long-bones from the skeleton are present in about equal frequencies and their relative abundance remains constant through time (Fig. 31.9). The majority of the sheep/goat remains are heavily fragmented and show many cut and/ or chop marks, indicating their status as consumption refuse. As is the case for the camelid remains, burnt bones are not uncommon, and most frequently they are only slightly charred and not cremated (which would result in a white colour). A large proportion of the articular ends of the long bones were unfused, indicating the young age of the animals consumed (Fig. 31.10). Age at slaughter of the sheep and goat has also been established using Grant (1982) and varies widely, from very young animals to very old individuals. Slaughter ages and survival curves for the different periods are given in Figure 31.11. Since there is only limited material from the Early Islamic period, this period has been omitted here. When sheep and goat are considered together, the

Ottoman and the Modern periods show a similar distribution of the age classes, with a preponderance of very young and old animals. That intermediate age classes are less well represented is also shown in the survival curves (Fig. 31.12) by a plateau around mandibular wear classes (MWS) 15–30. The group of young animals (up to a MWS of 15) corresponds with the moment that the first molar and the second molar erupt, or an age of up to 1 year (Silver 1963, data for improved breeds). The group of older animals (from approximately MWS 35 onwards) corresponds with animals in which the third molar is moderately to heavily worn; or an age of over 4 years. Clearly, animals of intermediate age, between 1 and 4 years were thus less frequently slaughtered.

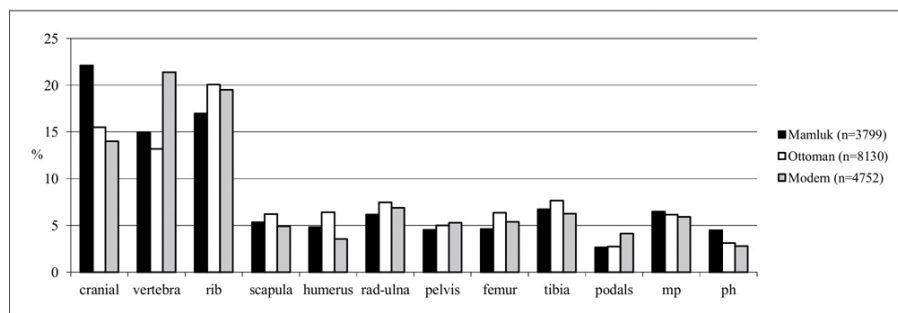


Fig. 31.9. Skeletal distribution of sheep/goat through time.

This model is characteristic for a herd from which some of the young (probably mostly males) are culled for their meat, and some are kept until older ages. Once mature, the latter portion (probably mostly females) of the herd might provide milk and wool, and sustain the size of the flock. Only when they are no longer suitable for one of these purposes, are they slaughtered. The different age classes are more evenly distributed during the Mamluk period. As a consequence the plateau in the survival curve is not visible, and the curve represents a more or less straight line (Fig. 31.12). This may be the result of differences in herd management compared to the Ottoman and Modern periods. Indeed, as sheep and goats may have been kept for different purposes, it is highly possible that slaughter ages differ according to the species considered. Consequently, all the results that present combined data for both sheep and goats have to be considered with caution.

Given the diachronic differences in the slaughtering patterns observed, an attempt was made to evaluate the possible impact of shifting species composition within the ‘sheep/goat’ group, by identifying the mandibles to species. For this purpose, the criteria

described by Payne (1985) for the morphology of the Pd4 were used, together with those defined by Halstead *et al.* (2002), i.e. taking into account the position of the foramen with respect to the P2–4 and the presence or absence of a hollow immediately posterior of the M3. The absence of the foramen, which is described by Halstead *et al.* (2002) as a characteristic for goat, has not been applied here. Indeed, the material of Aqaba comprised many mandibles that, based on the Pd4, were identified as sheep but were not showing a foramen. Identification as sheep was maintained in these cases. Mandibular wear stages of the individual species were then again evaluated for the different periods (Fig. 31.13). Only a few specimens were available for the Modern period; they have therefore been omitted here. The mandibular wear stages in goat show a more or less similar distribution for both periods, i.e. a dominance of a group of young animals, up to MWS 15, and of a group of old animals. The sheep, on the contrary show a distribution that changes from the Mamluk to the Ottoman period. During the Mamluk period two large peaks can be distinguished around MWS 14 and 25. These correspond with the eruption of the M2 and M3, at an age of approximately 1 and 2 years respectively (cf. Silver 1963, data for improved breeds). Clearly, only a smaller portion of the sheep reached maturity. The Ottoman period, however, shows a large peak around MWS 3–8 (M1 erupting to slightly worn), corresponding to an age of around 6 months. The peaks of around 1 and 2 years, as seen for the Mamluk period, are lacking, and more animals were kept into old age. Considering the fact that the Pd4 was used for species identification, it is likely that the portion of the young animals is somewhat overestimated but the differences in slaughtering patterns observed must certainly be related to different management strategies for the sheep and the goat herds (Payne 1973). The pattern observed for the goats at Aqaba is typically what can be expected when milk production is aimed for. In the case of wool production, both sexes will be kept into adulthood (Payne 1973). The slaughtering pattern of sheep at the castle shows a clear preponderance of young animals, which corresponds better with the model of meat production. Indeed, in the latter case, young animals of both sexes will be slaughtered (Payne 1973). While subadult animals, which render more meat, were preferred in the Mamluk period, an emphasis on lambs is observed in the Ottoman period. It is possible that this pattern is a reflection of changing management strategies and culinary practices.

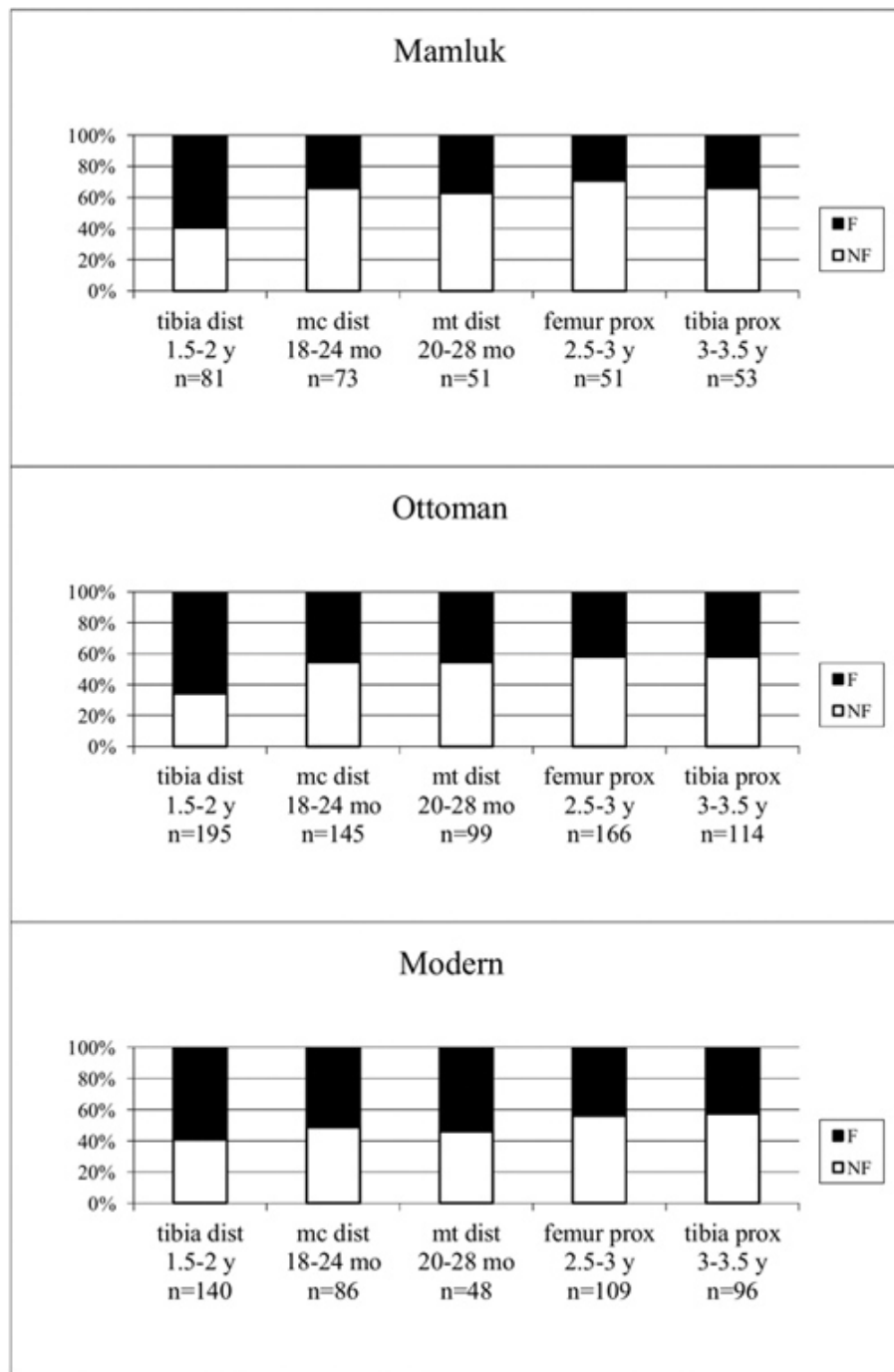


Fig. 31.10. Fusion stages of long bones of sheep/goat (F: fused; NF: unfused).

The ratio of sheep and goat also varies through time (Fig. 31.14). While sheep are better represented than goats during the Mamluk

period, the opposite is true for the Ottoman and the Modern period. The early periods also show a preponderance of goat, but the numbers involved are very low and the ratios are therefore not regarded as reliable. Considering the fact that the majority of the sheep must have been of a hornless breed, it seemed more correct for the calculation of the ratio not to include the horn cores. Mandibles, too, have been excluded, as the criteria to distinguish both species are not always unambiguous and mostly applicable on young specimens, i.e. with a Pd4 (see above). Therefore, only postcranial elements have been counted.

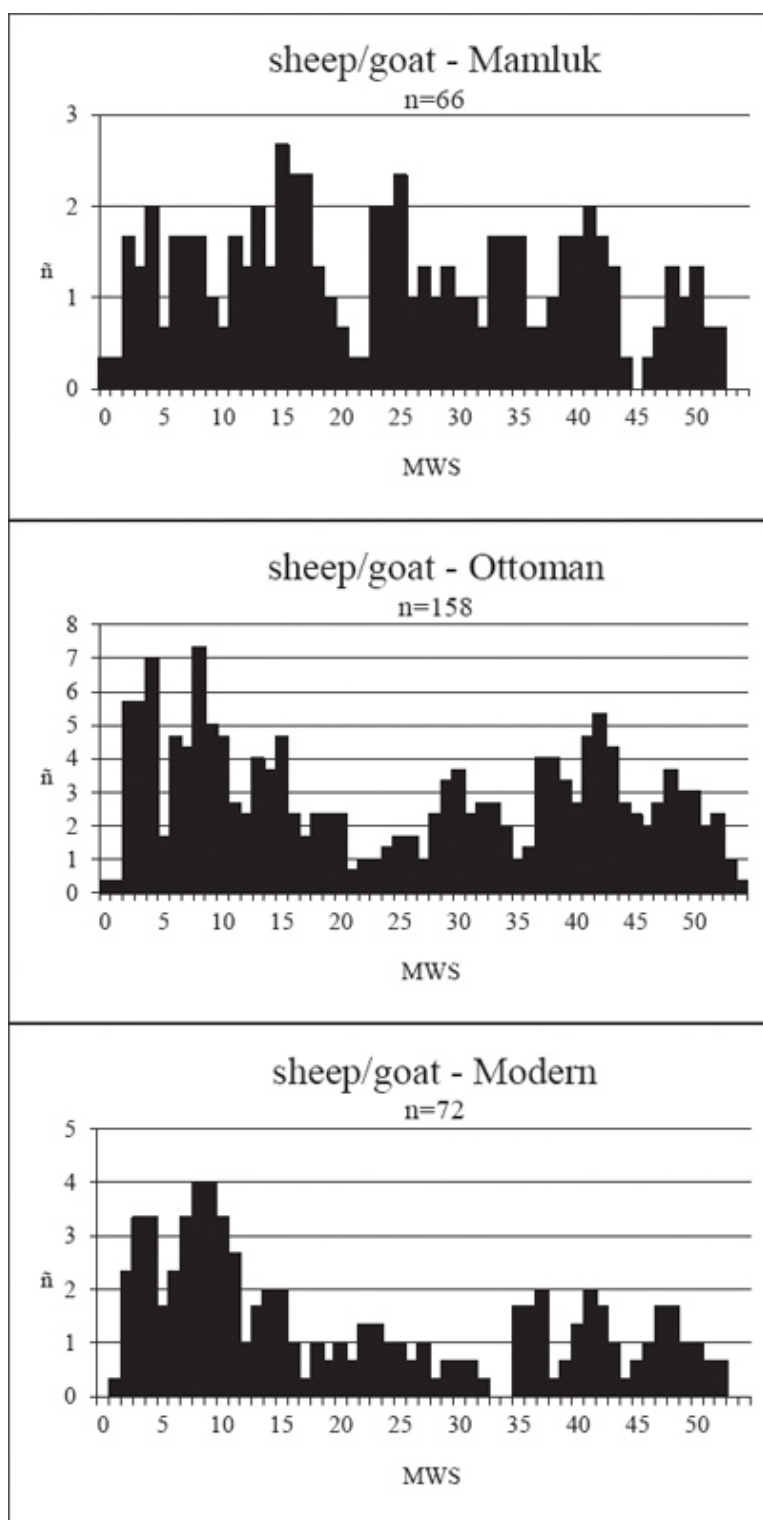


Fig. 31.11. Mandibular wear stages (MWS) of sheep/goat, according to

A summary of selected measurements is given in the appendix. Only the most abundant and complete bones are included, i.e. radius and metapodials. Height at the withers could be established from the total lengths of these long-bones, ranging between 44cm and 74cm in the case of the sheep, and between 51cm and 70cm in the case of the goats. One extremely large metacarpal of goat, dated to the Mamluk period and indicating a height at the withers of 85cm, may well be from ibex (*Capra nubiana*), which still occurred in the region at the beginning of the 20th century (Harrison & Bates 1991, 182). Species identification, however, remains uncertain. In general, a small size decrease could be observed for the small livestock from the Mamluk to Modern times (see [appendix](#)).

Cattle remains are very scarce; from a total number of 92 almost 40% were identified as metapodials and phalanges. They were relatively more abundant in the older levels. Indeed, while in the Early Islamic period cattle still account for about 2% of the domestic consumed mammals, their share decreases to about 1% in the Mamluk period, over 0.3% in the Ottoman period, to less than 0.2% in the Modern period. Almost all remains are from adult individuals.

Sieved samples

A sieved sample from a thin refuse layer, belonging to one of the older occupation periods, contained a number of small gastropods, minute fragments of mammal bones, and some small fish bones. Another sample, from one of the older refuse layers that was rich in charcoal, contained a similar spectrum of finds but with a higher density. In this case, fish scales and a large number of plates of mail shells (*Chitonidae*) were recovered. A sample from the topsoil, the context that yielded most of the hand-collected bones and displayed the best preservation conditions, contained virtually no small animal remains.

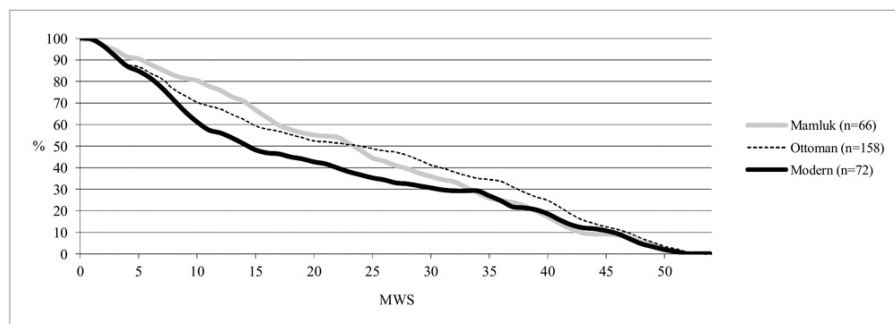


Fig. 31.12. Survival curves of the sheep/goat for the different periods.

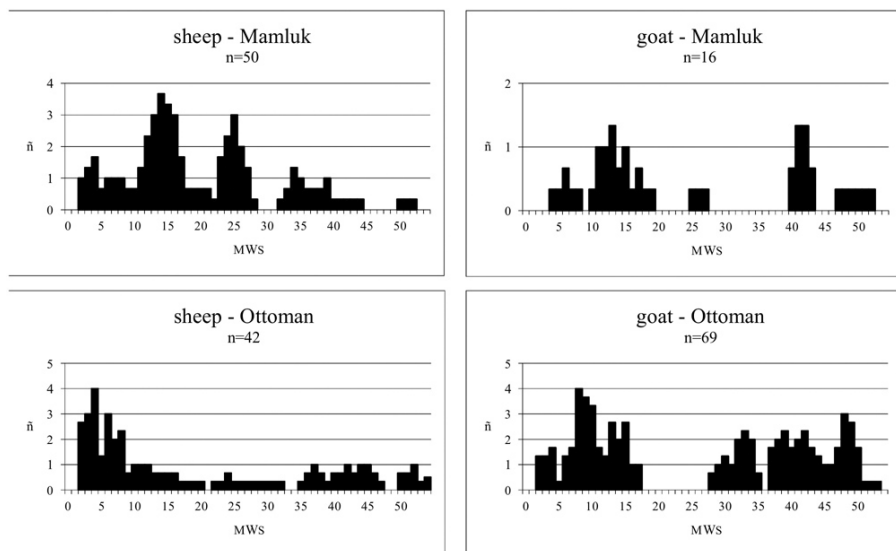


Fig. 31.13. Mandibular wear stages (MWS) of sheep and goat, according to Grant (1982); $\bar{n}$: running mean.

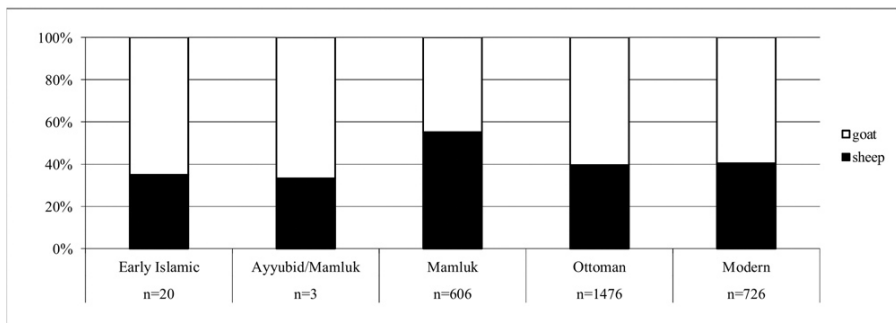


Fig. 31.14 Relative abundance of sheep and goat through time, based on NISP, excluding horn-cores and mandibulae.

The fill of a ceramic container without the base (AQ 2005 Y11), which had been put into the ground in order to serve as a sinkhole, contained a large number of fish bones and scales, mainly from Lethrinidae, Carangidae and Siganidae (Table 31.4). They were derived from both medium-sized and small fish. The sinkhole could be dated to the Mamluk period. The fill of a small water reservoir did not contain meaningful numbers of small animal remains.

Food provisioning at the Castle of Aqaba

The relative abundance of the different animal categories is shown in [Figure 31.15](#); the few turtle remains are not included here. The molluscs are not included either, but considering their large number within the faunal assemblage and the fact that the majority can be interpreted as consumption refuse, they indeed must have formed a substantial part of the diet of the inhabitants of the castle.

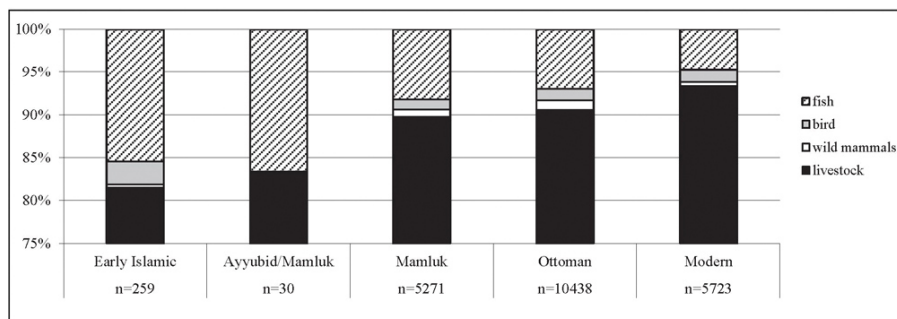


Fig. 31.15. Relative abundance of the main consumed animal groups through time, based on NISP.

Fish consumption must also have been of importance during the occupation of the castle, especially in the Early Islamic period. Although fish remains were never very numerous in the excavated contexts from the later periods, the presence of large specimens corroborates this statement. It is difficult to evaluate the consumption of small fish, as sieved samples were limited and contained little useful material. Possibly, the preservation of small fish remains is not ideal at the site. The sinkhole produced remains mainly from Lethrinidae, followed by Siganidae and Carangidae, thus compared to the hand-collected material a somewhat different composition becomes apparent.

When the fish fauna from the Late Roman site of ez-Zantur (Petra) is considered (sample size: $n = 433$), it is striking that no jacks at all have been found at this site; the groupers made up 35% of the identified fish remains, followed by the parrotfishes (21%), the emperors (19%) and the scombrids (17%) (Studer 2008). At Byzantine Jabal Harûn, located at about 5km southwest of Petra, parrotfish dominated the fish assemblage at 67% (sample size: $n = 2924$) and medieval Wadi Farasa (Petra) almost exclusively yielded remains of parrotfish (sample size: $n = 218$; Studer 2008). A high percentage of parrotfish was also observed at other inland sites, such as Deir 'Ain Abata and En Boqeq, both near the Dead Sea (Studer 2008). Although these sites are very distinct in nature, and certainly not comparable to the Castle of Aqaba, the high proportion of parrotfish in the Roman to medieval

period indicates that these fishes must have been ideal for trading. The proportion of parrotfish in the Mamluk assemblage of Aqaba is 40%, but its amount declines during the Ottoman period to less than 10%. At the same time, a larger proportion of emperors are observed, although from specimens of a smaller size. Through time, fishermen ventured further offshore, towards the open sea, as indicated by the larger quantities of jacks. The causes of these changes (overfishing, possible destruction of habitats, changing fishing techniques) are not well understood and need to be investigated using material from more sites and by more refined analyses (e.g. of the growth rate of the fishes). The huge number of fish remains collected from Roman Aila is still awaiting analysis. They may add valuable information to the current picture.

Hunting of wild birds and mammals provided only a small portion of the diet, an observation which was also made at Roman Aila (Parker 1998). Most of the food provisioning of the castle relied on domestic mammals (Fig. 31.15). When the relative abundance of livestock (Fig. 31.16) is considered, it is obvious that the bulk is made up of bones of sheep and goat. Their relative number increases through time, while the relative number of camelid bones decreases. Excavations of Roman Aila have also yielded camelid bones, although without any further identification to species level (Parker 1996). At Aqaba the ratio of sheep and goat varies through time (Fig. 31.14), illustrating a growing dominance of goat. This is in accordance with other observations in the country. Indeed, in the Late Roman assemblage of ez-Zantur sheep remains are – in a ratio of 2:1 – more numerous than the bones of goat, while today the Bedouins have herds mainly consisting of goats (Studer 1996).

The environment

The presence of pig has not been attested at the Castle of Aqaba. The complete absence of this animal is not surprising, considering the religious context of the inhabitants. But pig remains are also very scarce at Roman Aila (Parker 1996) and Nabatean Petra (Studer 2007). The arid nature of the environment certainly played a role in the paucity of the pig remains. Similarly, the low frequency of cattle remains can be explained by the environmental conditions, which excluded large-scale cattle breeding. The presence of pig and cattle at Roman Aila was interpreted as imports from external sources, rather than being an exploitation of locally raised herds (Parker 1996; 1998). As far as small livestock is concerned, the shift from herds with more sheep than goats in Mamluk times towards herds with an emphasis on

goat breeding in Modern times may be the consequence of either overexploitation of the environment (i.e. overgrazing) and/or changing climatic conditions. Humidity changes have indeed been described for the past centuries in Jordan (Shehadeh 1985). Although the described fluctuations for the Mamluk and Ottoman periods were not lasting long enough to have had a permanent impact on the environment, they may quite well have triggered a change in herd management, and also have induced the observed size decrease in sheep and goat (see [appendix](#)). Furthermore, several bird species that were still present during the occupation period of the Castle of Aqaba have now completely disappeared from the region. This may be the result of many factors: hunting, a loss of habitat under growing human pressure, climate changes.

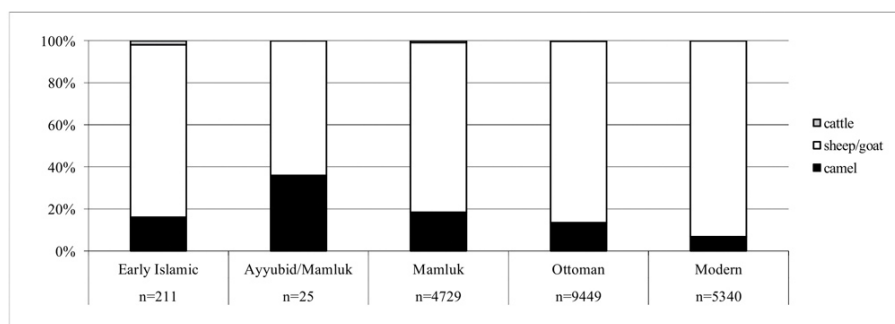


Fig. 31.16. Relative abundance of the consumed domestic mammals through time, based on NISP.

Conclusion

The analysis of the faunal remains yielded insight in the food provisioning of the castle inhabitants, especially for the Mamluk, Ottoman and Modern periods. Sea fishing and harvesting of shells contributed substantially to the diet while the amount of meat provided by hunting wild birds and mammals must have been rather small. The bulk of the animal food products came from sheep and goat and to some extent from camel. The consumption of beef was rather minute, and occurred mainly during the oldest occupation periods. Diachronic changes of the relative abundance of the different fish taxa indicate a shift towards more fishing in the open sea, simultaneous with a decrease in the contribution of fish in general. At the same time, a smaller proportion of parrotfish and a larger proportion of the emperors (but of smaller size) is observed. A shift in the management of sheep can be suggested from the age-of-death-profiles. While subadult animals were preferentially slaughtered in the Mamluk

period, an emphasis on lambs is observed in the Ottoman period. Slaughtering ages of the goats remain similar over the centuries. Through time, a shift towards goat dominated herds is observed, possibly to be related with a deterioration of the environment.

Acknowledgements

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This paper is dedicated to John De Meulemeester, the driving force behind the Aqaba Castle excavations, who died earlier in 2009. His support for environmental archaeology within the very traditional domain of medieval Mediterranean and Near Eastern archaeology has been much appreciated.

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Appendix – Aqaba castle. Selected measurements of the faunal remains (abbreviations after A von den Driesch (1976), all measurements in mm)

A. Measurements of wild birds – Alec: *Alectoris chukar*; Ammo: *Ammoperdix heyi*; Crex : *Crex crex*; Col : *Columba livia/oenas*; Corv: *Corvus corax*; Mam: Mamluk; Ott : Ottoman; Mod: Modern; A/M : Ayyubid/Mamluk.

	Alec	Crex	Col		Col	Corv						Alec	Corv
coracoid	Mam	Mam	Ott	Mod	Mam	Mod				scapula		Ott	Mod
GL	36.5	23.5	33.6	33.3	32.4	49.5				GL		60.4	
Lm	35.3	22.8	32.4	32.3	30.9	44.0				Dic		15.3	14.2
Bh					13.3								
BF	7.8	(6.2)	8.7	7.2	8.6	15.0							
	Alec	Ammo	Ammo	Crex	Crex	Crex	Col	Col	Col	Col	Strep	Corv	Corv
humerus	Ott	Ott	Ott	Ott	Ott	Mam	Ott	Mam	Ott	Ott	Ott	Ott	Ott
GL	49.6			41.9	41.5		47.0	44.1	42.8			81.6	81.6
Bp	13.8	10.0		7.7	8.6	8.8	18.5	17.3	16.0			21.9	
SC	4.6	3.5		2.8	2.8	3.1	5.2	4.9	5.1	4.9	4.9	7.4	7.3
Bd	10.0		8.0	6.0	6.1		11.1	10.4	10.5	10.3	8.1	19.2	18.0
	Corv	Corv	Corv	Corv								Strep	Corv
humerus	A/M	Ott	Ott	Ott						radius		Ott	Mam
GL	81.2	78.8	77.0							GL		37.1	92.7
Bp	21.1	20.6	20.0							SC		2.6	2.4
SC	7.5	7.3	7.1	6.8						Bd		3.9	7.0
Bd	20.0	17.2	17.9	17.4									
	Ammo	Col	Strep	Strep	Corv	Corv	Corv	Corv	Corv	Corv	Corv	Corv	Corv
ulna	Mam	Mam	Ott	Ott	Mod	Ott	Ott	Mam	Mod	Ott	Ott	Ott	Ott
GL	35.0		41.5		104.6	97.0	92.2						
Bp	4.4	6.6	5.6		12.1	12.0	11.1	12.2	11.3				
Dip	6.3	7.8	7.9		13.8	8.5				5.5			
SC	2.0		2.7		5.4	5.3	5.0						
Bd	4.6		5.4	5.1	11.3	10.8	11.4			11.0	10.6	10.4	10.4
	Alec	Crex	Col	Col	Corv	Corv	Corv	Corv	Corv	Corv			
carpometac.	Mam	Ott	Mam	Mam	Ott	Mod	Mam	Ott	Ott	Mod			
GL	29.5	25.9	32.0		61.7	58.8	55.2	54.2	53.7	53.5			
Bp	8.4		8.9			12.7	14.2	12.7	12.1	12.6			
Did	5.1			5.7		12.5		11.7		12.6			
	Alec	Alec	Crex	Crex	Crex	Strep	Corv				Alec	Alec	Alec
femur	Ott	Ott	Mod	Ott	Ott	Mod	Mam		tibiotarsus		Mod	Ott	Ott
GL	53.7		45.2			(34.3)			GL		66.2	73.2	73.3
Bp	11.2		7.0	8.0			11.4		Dip		10.8	12.1	11.9
Dp	7.0		4.7	5.1					SC		3.3	3.6	3.7
SC	4.1	4.0	2.7						Bd		6.8	7.1	6.9
Bd	9.7	9.5	5.9		6.2				Dd		6.9	7.2	7.2
Dd	7.6	7.4	5.6		6.0								
	Alec	Alec	Alec	Crex	Crex	Crex	Crex	Crex	Corv	Corv			
tibiotarsus	Ott	Mam	Mam	Mod	Ott	Ott	Mod	Mam	Ott	Ott			
GL				60.9					106.9				
Dip	14.0	11.9		7.8	8.1	8.1			15.6	13.3			
SC			3.6	2.7				2.9	5.4				
Bd			7.2	5.2			5.1	5.0	10.7				
Dd			7.0	5.5			5.5	5.6	10.3				
	Alec	Ammo	Crex	Crex	Crex	Col	Corv	Corv					
tarsometat.	Ott	Ott	Ott	Ott	Ott	Ott	Ott	Mam					
GL	74.6	32.6	39.6	38.4	37.5	31.2	65.0	63.0					
Bp	9.2	6.0	5.9	5.6	5.4	7.4	11.4	11.0					
SC	4.0	2.8	3.0	2.5	2.6	3.6	4.0	4.5					
Bd	10.1	6.2	6.1	5.5	6.3		8.0	8.0					

B. Measurements of chicken – Mam: Mamluk; Ott : Ottoman; Mod: Modern

coracoid	Mod	Mod	Mod	Ott						scapula		Ott	Ott
GL	56.2	52.9	49.7							GL		66.6	
Lm	54.3	50.5								Dic		12.0	11.8
Bb	13.6			13.4									
BF	11.8	10.6		10.6									
humerus	Mam	Mam	Ott	Mod	Mod	Ott	Mod	Mam	Mod	Ott	Ott	Mod	
GL	75.0	65.7	65.6	65.3	64.7	63.7	63.0	60.5	60.1				
Bp	20.0	18.8	17.5	17.5		16.8	18.1	15.5					
SC	7.8	6.4	5.9			5.8	6.0	5.8					
Bd	16.0	14.4	13.3	13.6		13.1	13.3	12.6		13.2	(16)	12.5	
radius	Mod	Ott	Ott	Ott						carpometac.	Ott	Ott	Mam
GL	74.3	58.8	55.1	51.1						GL	39.3	33.0	31.9
SC	3.5		2.9							Bp	12.3	10.6	10.0
Bd	7.5		6.0							Did	7.4	6.1	
ulna	Ott	-	Ott	Mod	Ott	Mod	Mam	Mod	Ott	Mod	Ott	-	Mam
GL	81.0	78.5	78.0	74.8	73.0	72.1	69.0	68.4	65.4	62.8	61.1	58.8	58.3
Bp	10.0		8.6		8.3		9.5		7.7				10.6
Dip	14.9		11.9		12.9		13.1		11.3				8.0
SC	4.5		4.1		4.4		4.1		3.8				3.2
Bd	10.3		9.3		9.3		9.5		8.1				8.1
ulna	Ott	Mod	-		femur		Ott	Mam	Ott	Mod	-	Mod	Mod
GL	55.0				GL		89.1	86.0	(77)	76.4	75.0	74.7	72.2
Bp	7.0	7.8			Bp		18.7	18.5	16.7				
Dip	10.0	11.0			Dp		12.4	11.9	11.2				
SC	3.4				SC		7.8	8.0	7.0				
Bd	7.5		9.1		Bd		19.5	18.0	15.7				
					Dd		15.1	15.3	13.2				
femur	Mod	Ott	Ott	Mod	Ott	Ott	Ott	Mod	-	Mod	Ott	Mod	Ott
GL	72.0	71.4	70.8	70.4	69.0	67.4	66.9	66.0	65.8				
Bp					15.0	63.0	14.7		13.6	19.2	14.7	12.7	
Dp			8.8		9.5	13.1	9.2		9.0			7.4	
SC			6.2		6.3	8.5	6.1		5.9				
Bd			14.0		13.4	5.3	13.7		12.9				14.7
Dd			11.7		11.2	12.9	11.9		10.6				
femur	Ott	Mod	Mod		tibiotarsus	Mod	Mod	Mam	Mod	Mod	Ott	Mod	
GL					GL	134.6	134.4	123.6	121.1	117.0	107.2	102.6	
Bp					Dip	24.1	24.0	22.0			17.5		
Dp					SC	7.8	7.8	7.6			6.4		
SC	7.0	8.1			Bd	14.4	14.4	12.3			10.8		
Bd	17.5	17.1	13.7		Dd	15.0	15.0	13.0			11.8		
tibiotarsus	Mam	Ott	Mam	Ott	Mam	Ott	Ott	Ott	Mod	Ott			
GL	99.2	89.4											
Dip	17.2	16.4	19.8										
SC	5.2	5.2		7.5		6.4	6.4	5.8	5.7	5.3			
Bd	10.8	10.2		14.3	12.2	11.9	11.5	11.1	10.6	10.5			
Dd	11.2	10.3		14.2		12.4	12.1	11.7	10.9	10.1			
tarsometat.	Ott	Ott	Mam	Ott	Ott	Ott	Mod	Mam	Mod	Mam	Ott		
GL	82.3	81.2	81.0	80.9	80.5	79.6	71.5	70.7	68.0	66.0			
Bp	14.9	15.0		13.8	13.4		13.1			12.1	11.8		
SC	7.7	7.4	7.0	6.9	6.7	6.8	6.9			5.5	6.0		
Bd	14.2	14.7	14.0		14.2	14.2	12.7			11.9			

C. Measurements of wild and domestic mammals – Hyae : *Hyaena hyaena*; Can: *Canis lupus* f. familiaris; Fel: *Felis silvestris* f. catus; Gaz : *Gazella gazelle*

	Hyae	Fel	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz
scapula	Mam	Ott	Ott	Ott	Ott	-	Mam	Mam	Ott	Ott	El	Ott	Ott
GLP	41.2	11.9	29.1	29.0	28.8	28.2	28.1	28.0	27.3	27.1	26.8	26.4	25.5
LG	33.9	11.0	23.7	22.1	22.9		21.7	22.5	(21.2)	23.7	22.3	21.2	21.1
BG	23.7	6.9	20.5	21.1	21.3		19.7	20.4	18.8	18.7	17.8	18.7	17.6
SLC	34,0	10.6	16.0	16.0				15.0	12.8	14.4	(14.6)	13.2	13.5
HS								114.9					
DHA			140.9					123.8					
	Hyae	Hyae	Hyae	Can	Can	Fel	Fel	Fel	Fel	Fel	Fel	Gaz	
humerus	Ott	Mam	Ott	Mam	Mod	Ott	Ott	mod	mod	Ott	mod	Mod	
GL						91,0	86.6						
Dp/Bp	57.5			35.8		20,0	18,1	18.8				32.4	
SC	15.7					6.8	6.0			7.3			
Bd		41.4	39.4		39.5	18.1	15.4		17.9	18.0	17.5		
BT													
	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz						Hyae
humerus	Ott	Ott	Ott	Ott	Ott	Ott	-				axis	Ott	
SC		12.6									BFer		36.1
Bd	27.4	27.0	26.6	26.2	25,0	24,6	24.2				SBV		21.7
BT	22.5	23.6	23,0	22.5	23.2	(23)							
	Hyae	Can	Fel	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz
radius	Mam	Mod	Ott	Mod	-	Ott	Ott	Mam	Mam	Ott	Mod	Ott	Ott
GL			83.5	175.6	165,0								
Bp			7.3	27.0	25.0	26,4	26.0	25.3	25.3	25.0	24.5	24.2	24.1
BFp						23.3	23.2	21.9	23.2	23.8	22.5		22.3
SD	15.3		5.2	16.2	14.9	15,0	16.5	15.5		15,0	13.5		13.5
Bd	30.	20.6	11.0	24.6	23.8								
	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz						
radius	Ott	Mod	Ott	Ott	Mod	Mam	-						
Bp	23.9	22.7											
BFp	22.3												
SD			14.2	13.8									
Bd			23.2	22.6	22.3	20.3	19.4						
	Fel	Fel	Fel		pelvis		Can	Can	Can	Fel	Fel	Fel	Fel
ulna	Mod	Ott	Ott		LAR		Ott	Mam	Ott	Ott	Ott	Ott	Mod
GL	109.0	108.6	97.7				22.9	19.8	16.7	11.4	10.4	10.1	9.8
	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz	Gaz						Can
mc	Mam	Mod	Ott	Mam	Ott	Mam	Ott				mc V		Mod
GL	183.0	183.0									GL		61.5
Bp	19.4	19.3	20.7	19.7									
SD	12.0	12.0											
Bd	19.9	19.9			20.6	20.2	18.6						
	Fel	Fel	Fel	Fel	Fel	Fel	Fel	Fel	Gaz	Gaz	Gaz	Gaz	Gaz
femur	Mod	Ott	Ott	Ott	Mam	Ott	Ott	Mod	Ott	Ott	Ott	Mam	Mam
GL	97.5	96.0	94.2										
Bp	118.0	17.2	18.5	20.0	18.3	17.5			44.1	40.0	34.7	34.0	
DC									17.7	16.0	15.0	14.4	
SD	7.0	7.2	7.3	9.1	8.2	7.7	8.1						
Bd	16.6	16.4	17.4				17.9	18.1					33.1
	Gaz	Gaz			talus		Gaz	Gaz					Gaz
femur	Mam	Ott			GLI		Ott	Ott			calcaneus		Mam
SD	14.9				GLm		26.0	25.0			GL		55.5
Bd	32.2	31.1			DI		23.5	23.1					
					Bd		14.1	13.6					
							15.8	15.6					

tibia	Fel Ott	Fel Ott	Fel Mam	Fel Ott	Gaz Mam	Gaz -	Gaz Ott	Gaz Ott	Gaz -	Gaz Mod	Gaz Ott	Gaz Ott
GL	106.3											
Bp	18.8	17.5	17.5		(36)	34.9						
SD	6.8	7.5		6.3			15.4			12.7		
Bd	14.2			12.4			24.1	22.2	21.5	21.4	21.1	21.1
	Gaz Ott	Gaz Ott	Gaz Mam	Gaz -	Gaz Ott	Gaz Mod	Gaz Ott	Gaz Ott	Gaz Mod	Gaz Mod		
mt	207.7	181.6										
GL	21.9	18.4	20.2	18.3	17.1	16.7	16.1					
Bp	12;0	9.8	11.0				8.8	12.3		10.4		
SD	23.3	19.8						19.7	18.3	18.5		
Bd												
	Gaz Mod	Gaz Mod	Gaz Ott	Gaz Ott	Gaz Ott	Gaz -						Gaz Ott
ph1	44.3	41.7	41.0	39.5	39.0	34.8					ph2	23.2
Glpe		9.1	8.4	10.2	10.4						GL	
Bp											Bp	9.8
SD		7.0	6.8	7.2	7.7						SD	7.1
Bd		8.5	8.5	9.0	8.7						Bd	8.3

E. Selected measurements of sheep (*Ovis ammon* f. aries) and goat (*Capra aegagrus* f. hircus)

goat	radius					sheep	radius				
<i>Mamluk</i>	mean	SD	min	max	n	<i>Mamluk</i>	mean	SD	min	max	n
GL	141.5	6.4	137.0	146.0	2	GL	-				-
Bp	30.1	3.5	26.9	39.5	17	Bp	34.0	1.9	30.2	36.8	11
Bd	27.4	2.1	25.3	31.4	7	Bd	30.2	0.5	29.6	30.6	3
<i>Ottoman</i>	mean	SD	min	max	n	<i>Ottoman</i>	mean	SD	min	max	n
GL	148.3	6.8	138.8	157.0	10	GL	159.0	12.1	143.5	170.1	5
Bp	29.2	3.2	21.3	40.0	107	Bp	33.2	2.4	26.8	37.2	30
Bd	28.6	2.8	25.0	37.0	33	Bd	31.9	3.5	26.9	38.2	14
<i>Modern</i>	mean	SD	min	max	n	<i>Modern</i>	mean	SD	min	max	n
GL	143.3	4.9	140.0	149.0	3	GL	-				-
Bp	30.0	3.6	25.2	43.0	51	Bp	33.4	3.0	25.2	39.6	28
Bd	28.1	1.9	25.6	33.3	16	Bd	29.0	7.8	3.9	35.4	14
goat	metacarpus					sheep	metacarpus				
<i>Mamluk</i>	mean	SD	min	max	n	<i>Mamluk</i>	mean	SD	min	max	n
GL	103.7	14.7	95.8	148.0	12	GL	133.3	2.8	130.0	135.0	3
Bp	22.8	2.0	20.0	27.7	20	Bp	25.9	2.0	22.2	29.6	23
Bd	25.5	2.0	24.0	30.4	10	Bd	28.2	2.7	23.9	31.8	6
<i>Ottoman</i>	mean	SD	min	max	n	<i>Ottoman</i>	mean	SD	min	max	n
GL	100.8	5.6	89.8	112.3	23	GL	125.2	14.2	89.6	142.6	15
Bp	22.5	2.2	17.2	27.4	50	Bp	24.6	2.1	21.1	30.0	28
Bd	25.2	2.4	20.5	31.2	29	Bd	27.5	2.1	23.7	32.7	21
<i>Modern</i>	mean	SD	min	max	n	<i>Modern</i>	mean	SD	min	max	n
GL	98.1	4.4	89.0	107.3	23	GL	129.0	1.4	127.0	130.0	4
Bp	21.6	1.3	18.7	24.7	25	Bp	26.5	1.7	24.8	29.3	6
Bd	24.3	1.3	20.5	25.8	20	Bd	26.8	2.6	22.1	29.3	6
goat	metatarsus					sheep	metatarsus				
<i>Mamluk</i>	mean	SD	min	max	n	<i>Mamluk</i>	mean	SD	min	max	n
GL	111.7	8.4	104.0	125.6	5	GL	138.5	4.9	134.5	144.0	3
Bp	20.2	3.4	17.3	29.1	12	Bp	21.7	1.5	19.3	24.8	22
Bd	23.7	2.3	21.3	27.6	7	Bd	25.4	1.4	24.2	27.3	6
<i>Ottoman</i>	mean	SD	min	max	n	<i>Ottoman</i>	mean	SD	min	max	n
GL	108.4	7.0	100.3	131.6	20	GL	135.8	11.4	115.4	154.5	12
Bp	18.4	1.7	13.4	25.2	40	Bp	21.4	1.4	17.7	24.1	36
Bd	22.4	1.6	19.9	27.0	27	Bd	25.2	1.6	23.0	28.8	16
<i>Modern</i>	mean	SD	min	max	n	<i>Modern</i>					
GL	-				-	GL	-				-
Bp	20.9	3.5	17.5	25.0	5	Bp	-				-
Bd	-				-	Bd	-				-